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MOVAL RESPONSE REPORTS (CONTRACTOR) 10/30/91 - 12/11/92

WESTON®
MANAGERS DESIGNERS/CONSULTANTS
ROY F. WESTON, INC.
REAC PROJECT
11 SPIRAL DRIVE
SUITE 6-7, BUILDING B
FLORENCE, KENTUCKY 41042
606-282-7868

11-21-91

Rob -

Art Ball called me yesterday and asked that I send you a copy of my Bluewater Trip Report. I tried to keep it succinct.

Jerry

(Looks like we'll have the #1 draft choice. Interested in trading Warren Moon for it ?)

ROY F. WESTON, INC.
REAC PROJECT
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FLORENCE, KENTUCKY 41042
606-282-7868

TO: Art Ball, EPA Work Assignment Manager

FROM: Gerald L. Gels, REAC Task Leader Gerald L. Gels

THRU: GLG for GAB
Gary Buchanan, O&A Section Chief

SUBJECT: BLUEWATER URANIUM MINE SITES
WORK ASSIGNMENT #3-547 -TRIP REPORT

DATE: October 30, 1991

BACKGROUND

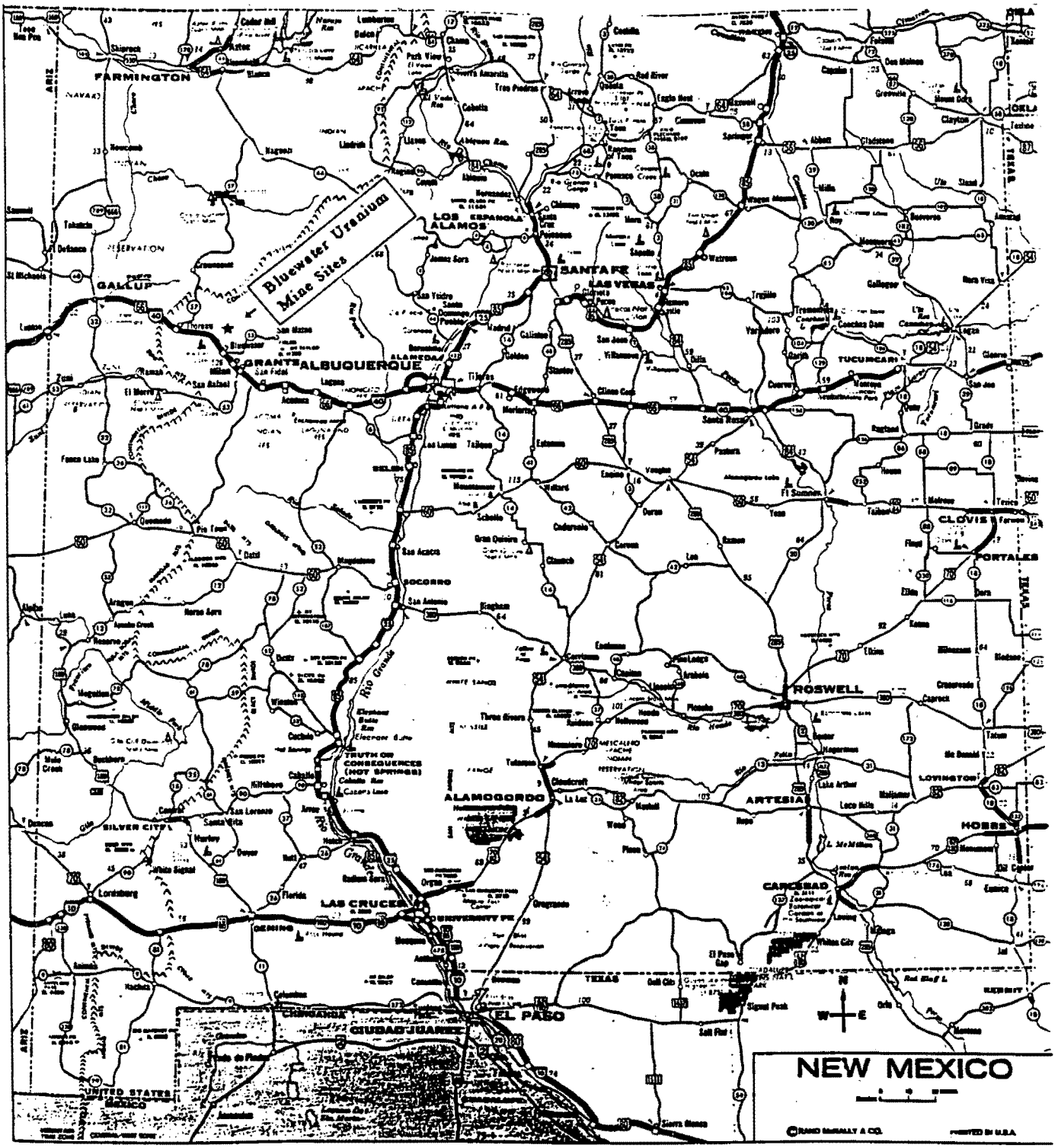
In November of 1990, the Federal Agency for Toxic Substance and Disease Registry (ATSDR) issued a Public Health Advisory concerning the Bluewater Uranium Mine Sites. This followed a preliminary assessment by U.S. EPA and several meetings among a number of federal and state agencies as well as Navajo representatives and former owners of the mineral rights. The result was an Action Memorandum directing the U.S. EPA Emergency Response Section (ERS) to conduct a removal action. The ERS tasked the U.S. EPA Environmental Response Team (ERT) who in turn tasked the Response Engineering Analytical Contractor (REAC, Roy F. Weston, Inc.) with assisting in this removal action.

The Bluewater Uranium Mine Sites consist of three parcels of land located about 15-20 miles NNW of Grants, NM (see Figure 1). Two of the parcels, Nanabah-Vandever (Section 24) and Brown-Vandever (Section 18), are at the base of Haystack Mountain, on the southern flank, at an altitude of about 7000 ft above sea level. The third parcel, Navajo-Desiderio is about 5 miles ESE of the others at about the same altitude. All three of the sites were strip-mined for uranium between 1952 and 1970. In addition, subsurface mining also took place at the Brown-Vandever and the Desiderio parcels. Piles of rubble and low-grade ore were left at all three sites, with gamma radiation levels ranging from background [~15 microroentgens per hour (μR/hr)] to about 1000 μR/hr in some places.

REAC was mobilized by ERT Work Assignment Manager Art Ball and tasked with providing Health Physics coverage for workers at the Bluewater Site and with conducting gamma surveys of the site both before and after the removal action. Task Leader, Gerald Gels, wrote a Work Plan and Health and Safety Plan and assembled radiation equipment from the Cincinnati REAC office. Ken Munney assembled the remaining equipment from the Edison REAC office.

OBSERVATIONS AND ACTIVITIES

The above personnel and equipment arrived in Grants, NM, on August 12, 1991. Prior to going to the site, several activities occurred. The REAC Task Leader made a calculation of the dust concentration in air that would require respiratory protection (see Appendix A). Conservative assumptions were made; namely, that the maximum soil radionuclide concentrations measured during the EPA preliminary assessment were present in all airborne dust, that this dust was present for 60 hours per week, and that no respiratory protection was employed.



U.S. EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING ANALYTICAL CONTRACT
68-03-3482

FIGURE 1
SITE LOCATION
BLUEWATER URANIUM
PREWITT, NEW MEXICO
1991
WA# 3347-31-01-4547

The calculated concentration of dust in air at which Level C respiratory protection would be required was 170 micrograms of dust per liter of air ($\mu g/L$). Subsequent on-site measurements at numerous locations and times indicated that short-term dust concentrations were less than 1% of this value.

A meeting was held on August 12, 1991, between the U.S. EPA Region IX On-Scene Coordinator (OSC), Rob Bornstein, the ERT Work Assignment Manager, Art Ball, U.S. EPA Region IX Office of Radiation Programs (ORP) health physicist, Steve Dean and Weston REAC personnel, Gerald Gels and Ken Munney. Site conditions and Health and Safety considerations were discussed as well as general strategies for accomplishing the objectives.

Activities at Bluewater were divided into 5 categories:

- Constructing gamma survey grids;
- Gamma survey data management;
- Health physics coverage of the site and workers;
- Checks on reclamation activities; and,
- Miscellaneous health physics assignments at the request of the Work Assignment Manager.

The categories of gamma survey grids and data management can be further subdivided by site into Pre- and Post-reclamation subcategories.

On August 13, 1991, after an initial safety meeting, radio check, and an initial walk-through at the Vandever site (Sections 18 and 24, see Figure 2), work began on laying out the first grid for the gamma survey of the Nanabah parcel (Section 24).

Gamma Survey Grids (Pre-reclamation)

Pre-Reclamation, Section 24

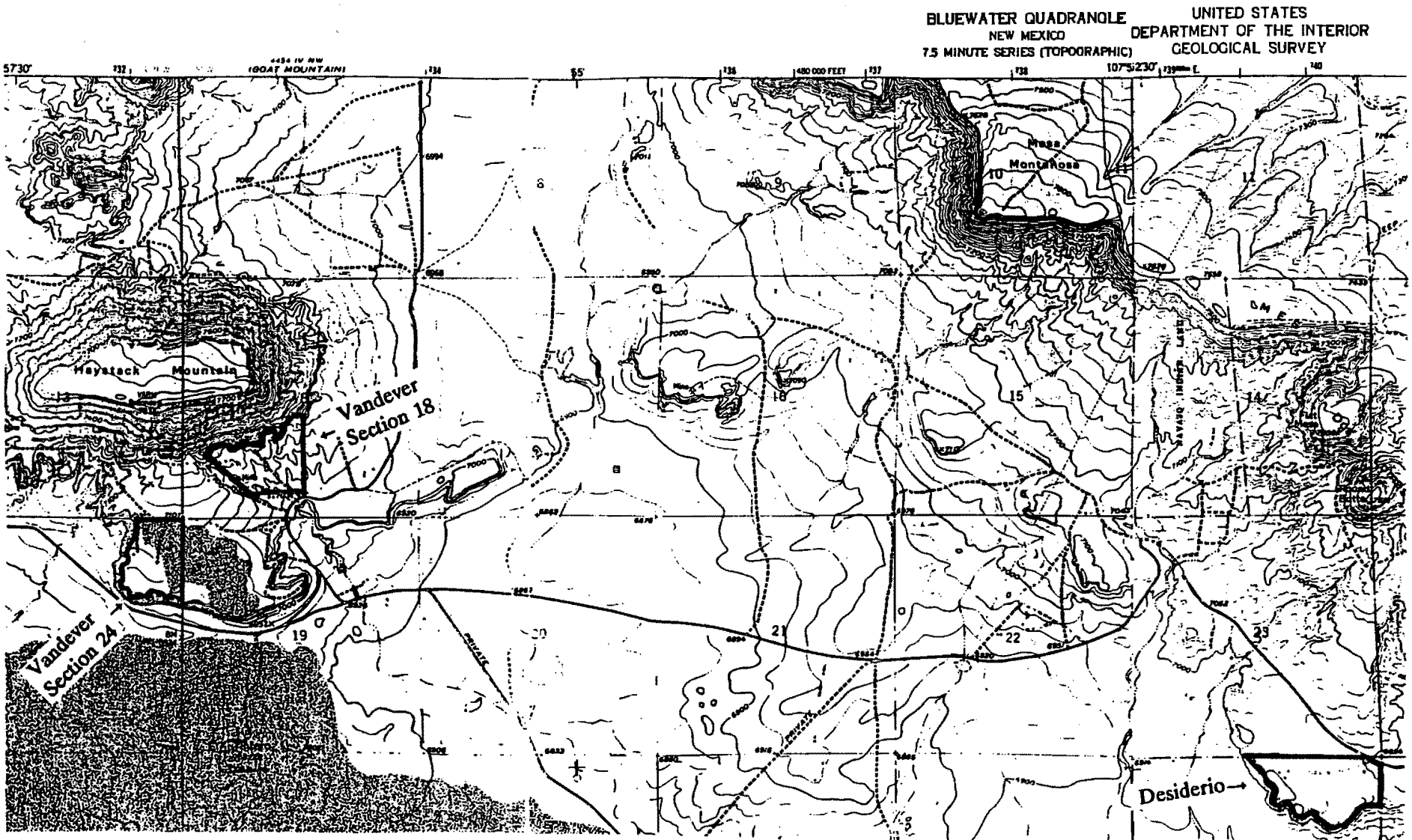
A 50-foot rectangular grid was laid out on Section 24 beginning on August 13, 1991. Beginning from a surveyed point at the northeast corner of Section 24, axes were laid out 900 ft. to the west and 1350 ft. to the south. A Brunton compass and 300-foot tapes were used to establish the nodes of the 50-ft X 50-ft grid. Assisting on grid activities were Jerry Gels and Ken Munney of REAC; Art Ball, Rob Bornstein and Steve Dean of U.S. EPA; and Patrick Antonio and Stanley Edison of the Navajo Superfund Office. Once the grid was completed, gamma exposure rate measurements were taken at the nodes using Ludlum model 19 survey instruments. Following the node measurements, a survey for "hot spots" was done over the area between the nodes. Any measurements significantly greater than adjacent nodal values were recorded. Both visual observation and survey instrument responses were used as inputs in the search for elevated readings. All data were recorded on log sheets for later transcription into a computer database.

Pre-Reclamation, Section 18

A 50-foot rectangular grid was laid out on Section 18 beginning on August 15, 1991. Beginning at an arbitrary point, a North-South axis was established. From that axis, at 50-foot intervals, East-West lines were run with nodes every 50 ft. The area involved, as well as the terrain, was far less imposing compared to Section 24. There were only 130 nodes in the Section 18 grid compared to 431 in Section 24.

Pre-Reclamation, Desiderio

A different approach was used for the larger and more rugged Desiderio site, based on experience gained on Sections 24 and 18. Instead of laying out a grid of stakes, starting on August 19, 1991, three different gamma survey teams went over the site taking readings at points distinguishable on the EPA aerial survey photos of the site. Readings were logged directly onto copies of the aerial photo and later were translated onto grid coordinates on a "master" map devised by REAC. All parts of the larger Desiderio site were thus covered, resulting in a total of 319 measurement points.



U.S. EPA ENVIRONMENTAL RESPONSE TEAM
RESPONSE ENGINEERING ANALYTICAL CONTRACT
68-03-3482

FIGURE 2
VANDEVER & DESIDERIO MINE LOCATIONS
BLUEWATER URANIUM
PREWITT, NEW MEXICO
1991
WA# 3347-31-01-4547

Gamma Survey Data Management

Gamma survey data from each of the three mine sites were entered into a LOTUS 123 database, where survey meter correction factors were applied and the data were prepared for use in other software programs which would produce maps of gamma radiation contours at each site. This data entry was fairly straightforward for Section 24 and Section 18 data. For the Desiderio site, however, artificial coordinate values had to be created from an aerial photograph and applied to each of the radiation measurements. Although this process required additional computer time, there was a significant net savings in time from not having to establish a physical grid over the very large Desiderio site. Following creation of each database (Appendix B), all data was supplied by REAC to the OSC who created the corresponding gamma radiation contour maps. Although waist-level and ground-level gamma measurements were taken at most locations, only the waist-level measurements were used for production of contour maps.

Health Physics Coverage

All non-resident personnel entering each site while work was being conducted were required to log in at the Health Physics checkpoint established near the access road to the site. Upon leaving the site, each worker and visitor were checked for gamma radiation on hands and feet, using a thin-window pancake Geiger-Mueller (GM) detector and a Victoreen model 290 (Thyac IV) survey meter. Background on this meter was between 70 and 120 counts per minute. During all field activities, no readings significantly different from background were observed for people, equipment or vehicles. Tires and wheel wells of each vehicle were surveyed thoroughly each time the vehicle left the site. All contractor equipment was surveyed thoroughly prior to final demobilization. No contamination was detected. Frequent airborne dust concentration measurements were taken (see Appendix C) to determine whether respiratory protection was required (per Appendix A). At no time did any measured dust concentration reach even 1% of the level that would require level C respiratory protection. Over the approximate 5-week period of time during which earth moving operations were taking place, the calculated dose due to inhalation of airborne dust at the Bluewater Mine Sites was approximately 0.03 millirem (mrem) committed effective dose equivalent (cede). This additional dose is approximately comparable to the background dose a person would receive from natural sources in one hour.

Radiation Measurements During Reclamation

Using the pre-reclamation gamma radiation contours, the general reclamation strategy was to move the highest activity material into pits or low-lying areas (either natural or created by the removal of "clean" dirt for use as final cover). After that, intermediate levels were added, followed by "clean" dirt. The site was then graded for erosion control and proper drainage. During this process, progress was checked frequently using the Ludlum model 19 microR meter. At times, earth moving activities uncovered pockets of material with elevated radiation levels. During these activities, U.S. EPA and REAC personnel frequently checked the new terrain. When problems were uncovered, immediate corrective actions were taken.

Gamma Survey Grids (Post-reclamation)

Post-Reclamation, Section 24

The U.S. EPA objective for site reclamation was an average waist-level gamma radiation level of less than 165 μR/hr. A post-reclamation waist-level gamma survey on Section 24 was conducted beginning on August 27, 1991. Some hot spots were discovered. Since the earth-moving equipment was at hand, these areas were covered immediately and resurveyed to verify the new levels and to be certain that other problems had not been created. In the end, all data for Section 24 was at or below 56 μR/hr, with the mean value of 28 μR/hr, well within the site objective. [A reading of 80 μR/hr on the south axis of Section 24 was determined to be caused by radiation from the as-yet-unreclamated Section 19 immediately adjacent. All pre- and post-reclamation data are presented in Appendix B.] Signs were installed at numerous locations around Section 24 and the other sites, stating in 3 languages (English, Navajo and Spanish), "Potential Radiological Hazard Below Surface."

Post-Reclamation, Section 18

On August 31, 1991, the waist-level gamma survey was begun on Section 18 by Craig Dodd of REAC. The highest value found on this survey was 34 μR/hr. The mean reading over the entire grid was less than 13 μR/hr, which is statistically indistinguishable from background in that area.

Post-Reclamation, Desiderio

On September 13, 1991, the waist-level gamma survey of the Desiderio site was begun. A starting point was selected that could be identified on the pre-reclamation aerial photograph. From that point, North-South and East-West axes were established using a compass and measuring tape. Due to the larger area of the Desiderio site, a 100 ft X 100 ft grid was established and waist-level measurements were taken with the Ludlum model 19 microR meter. The western 70% of the site (closest to the residences) was surveyed in this manner. The post-reclamation survey grid was also expressed in terms of the pre-reclamation grid points, so pre- and post-radiation contour maps could be compared. The results showed that the highest reading after reclamation was 50 μR/hr, and the mean over the entire surveyed area was less than 16 μR/hr. During a general site survey, one area of exposed rock was discovered which read 50 to 55 μR/hr at waist level in an area that had obviously had no mining activities. This provides a point of comparison by which the EPA efforts at these sites can be judged.

Miscellaneous Assignments

During the course of the field work, REAC was asked to contribute toward completion of a number of miscellaneous health physics assignments. These are summarized as follows:

Instrument Calibrations

There were 5 different Ludlum model 19 microR meters available for use at the Bluewater sites [2 from REAC, 2 from U.S. EPA, and 1 from Santa Fe Pacific Minerals Co. (SFPM)]. Some of these instruments had not been calibrated recently, and none had been calibrated using uranium, so REAC assisted EPA health physicists in performing the instrument cross-calibrations. These were performed at approximately waist level at various areas in Section 18 that had different radiation levels. Comparing the other instruments to the one from EPA Region IX (ORP),

ORP = EPA (Las Vegas)/1.0
ORP = (SFPM)/0.74
ORP = (REAC)/0.70

These conversion factors were used throughout the field exercise when comparing data.

Radon Assessment at Bluewater Sites

Following discussions of radon issues at the Bluewater sites with Rob Bornstein, OSC, and Dr. Gaurav Rajen of the Navajo Superfund Office, REAC was requested by the Work Assignment Manager to writee a summary assessment of radon issues at the Bluewater Uranium Mine Sites. This was completed and is included as Appendix D.

Soil Sampling

Toward the end of field activities, the OSC arranged for the U.S. EPA laboratory in Montgomery, Alabama to analyze a total of 10 soil samples for isotopic uranium and radium. REAC was requested to assist in development of a sampling plan that would best meet the U.S. EPA objectives. Ultimately, it was decided that a background sample would be collected from areas near each parcel that were obviously undisturbed by mining activities (for example, areas that contained trees greater than 40 years old). The remaining 7 samples would consist of: 1 sample from Section 18, and 3 samples each from Section 24 and Desiderio. Each sample was to be a composite of approximately 45 evenly-spaced scoops within the specified area (Section 18 as a whole was considered a single area). The resulting composite sample, weighing about 3

kilograms (kg), was then thoroughly mixed in the field, and a 1 kg aliquot of it was removed for laboratory analysis. The remainder of the sample was archived for future use. Since the seven samples of interest were from areas recently bulldozed, no depth restrictions were put on the samples, but all sampling was done in the top 15 centimeters (cm) of the reclamated areas. Background samples were more likely representative of about a 5-cm depth in undisturbed soil.

CONCLUSIONS AND RECOMMENDATIONS

Field operations went as planned and were successful. Average and maximum post-reclamation radiation levels were well below the target levels set prior to commencement of work. No detectable contamination was found on any personnel or equipment. Radiation doses to personnel due to inhalation of airborne dust from the site were also estimated to be very low, averaging less than 1 mrem per year. No future activities are planned.

APPENDIX A
PERMISSIBLE DUST CONCENTRATIONS
BLUEWATER URANIUM
TRIP REPORT
AUGUST 12 - SEPTEMBER 19, 1991

Bluewater Uranium Mines Site
Permissible Dust Concentrations

	Maximum measured concentrations		rem(lung)/μCi of intake	Class W	Class Y
^{238}U:	390 pCi/g	=	3.9×10^{-4} μCi/g	52	1000
^{235}U:	29	=	2.9×10^{-5}	56	1000
^{234}U:	330	=	3.3×10^{-4}	59	1100
^{226}Ra:	450	=	4.5×10^{-4}	59	--

If a person inhaled one gram (1 g) of dust at maximum measured concentrations, he would inhale:
3.9×10^{-4} μCi of ^{238}U leading to a (50 yr) lung dose of .0203 rem
2.9×10^{-5} ^{235}U .0016
3.3×10^{-4} ^{234}U .0195
4.5×10^{-4} ^{226}Ra .0266
using the Class W lung retention factors.

Summing the doses from the four radionuclides gives a total lung dose per gram of dust inhaled of
.068 rem(lung)/g(dust)
Or, using a lung weighting factor of 0.12,
.0082 rem(cede)/g(dust)
Or,
8.2 mrem(cede)/g(dust) [Class W]

Doing the same exercise for Class Y factors for the uranium isotopes, a person would inhale (per gram of dust):
3.9×10^{-4} μCi of ^{238}U leading to a (50 yr) lung dose of .390 rem
2.9×10^{-5} ^{235}U .029
3.3×10^{-4} ^{234}U .363
4.5×10^{-4} ^{226}Ra .0266
using the Class Y lung retention factors.

Summing the doses from the four radionuclides gives a total lung dose per gram of dust inhaled of
.81 rem(lung)/g(dust)
Or, using a lung weighting factor of 0.12,
.097 rem(cede)/g(dust)
Or,
97 mrem(cede)/g(dust) [Class Y]

To keep the dose for the job below 100 mrem per 60 hr. week, or 1.67 mrem/hr, one could not breathe dust at a concentration greater than w_c (for Class W) or y_c (for Class Y), where

$$w_r = [1.67 \text{ mrem/hr}]/[8.2 \text{ mrem/g}] = .204 \text{ g/hr}$$

and

$$y_r = [1.67 \text{ mrem/hr}]/[97 \text{ mrem/g}] = .0172 \text{ g/hr}$$

So, at 20 L/min x 60 min/hr = 1200 L/hr, the dust concentration must be less than:

$$w_c = [.204 \text{ g/hr}]/[1200 \text{ L/hr}] = 1.7 \times 10^{-4} \text{ g/L} = 170 \text{ } \mu\text{g/L}$$

and

$$y_c = [.0172 \text{ g/hr}]/[1200 \text{ L/hr}] = 1.43 \times 10^{-5} \text{ g/L} = 14.3 \text{ } \mu\text{g/L}$$

These are the dust concentrations at which respiratory protection is required. This calculation is based upon the highest measured concentrations of each nuclide and the presence of the calculated dust concentrations for 60 working hours per week.

G. L. Gels
8/11/91

APPENDIX B
GAMMA SURVEY DATA, PRE- AND POST-RECLAMATION
BLUEWATER URANIUM
TRIP REPORT
AUGUST 12 - SEPTEMBER 19, 1991

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
0	0	30	125
-1	0	20	20
-2	0	23	23
-3	0	19	21
-4	0	24	20
-5	0	24	48
-6	0	28	28
-7	0	68	70
-8	0	25	25
-9	0	23	23
-10	0	20	20
-11	0	25	28
-12	0	41	56
-13	0	28	23
-14	0	44	55
-15	0	33	33
-16	0	48	95
-17	0	33	35
-18	0	20	18
0	-1	23	24
-1	-1	20	22
-2	-1	22	22
-3	-1	24	25
-4	-1	65	35
-5	-1	100	85
-6	-1	50	55
-7	-1	25	22
-8	-1	27	32
-9	-1	29	29
-10	-1	24	23
-11	-1	24	25
-12	-1	65	60
-13	-1	31	27
-14	-1	65	65
-15	-1	27	26
-16	-1	50	60
-17	-1	36	40
-18	-1	23	21
0	-2	115	200
-1	-2	46	29
-2	-2	90	75
-3	-2	94	81
-4	-2	31	33
-5	-2	29	26
-6	-2	28	28
-7	-2	81	125
-8	-2	25	23
-9	-2	20	20
-10	-2	23	23
-11	-2	23	23

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-12	-2	75	94
-13	-2	40	38
-14	-2	55	45
-15	-2	38	38
-16	-2	28	23
-17	-2	20	19
-18	-2	18	16
0	-3	130	125
-1	-3	44	46
-2	-3	39	38
-3	-3	28	27
-4	-3	26	26
-5	-3	24	24
-6	-3	25	24
-7	-3	26	25
-8	-3	25	24
-9	-3	27	26
-10	-3	35	30
-11	-3	39	40
-12	-3	90	115
-13	-3	46	44
-14	-3	40	42
-15	-3	44	38
-16	-3	40	39
-17	-3	20	21
-18	-3	16	17
0	-4	33	31
-1	-4	30	26
-2	-4	29	29
-3	-4	31	31
-4	-4	31	35
-5	-4	35	33
-6	-4	25	25
-7	-4	28	28
-8	-4	30	30
-9	-4	29	29
-10	-4	31	31
-11	-4	54	54
-12	-4	90	95
-13	-4	65	65
-14	-4	155	230
-15	-4	30	29
-16	-4	25	25
-17	-4	18	18
-18	-4	18	18
0	-5	24	25
-1	-5	27	27
-2	-5	30	31
-3	-5	35	36
-4	-5	41	39

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-5	-5	33	30
-6	-5	26	26
-7	-5	29	28
-8	-5	38	40
-9	-5	41	40
-10	-5	65	60
-11	-5	80	130
-12	-5	80	75
-13	-5	90	85
-14	-5	135	180
-15	-5	70	65
-16	-5	50	40
-17	-5	27	27
-18	-5	24	23
0	-6	36	31
-1	-6	33	29
-2	-6	80	90
-3	-6	46	44
-4	-6	33	30
-5	-6	28	28
-6	-6	31	31
-7	-6	34	35
-8	-6	31	31
-9	-6	30	30
-10	-6	75	75
-11	-6	100	140
-12	-6	95	120
-13	-6	80	90
-14	-6	95	95
-15	-6	90	90
-16	-6	36	34
-17	-6	29	28
-18	-6	20	21
0	-7	36	36
-1	-7	32	33
-2	-7	31	31
-3	-7	30	29
-4	-7	39	37
-5	-7	50	40
-6	-7	60	40
-7	-7	50	50
-8	-7	80	100
-9	-7	65	75
-10	-7	40	41
-11	-7	35	34
-12	-7	40	35
-13	-7	55	50
-14	-7	140	210
-15	-7	27	28
-16	-7	29	28

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	uR/hr Ground
-17	-7	30	30
-18	-7	25	26
0	-8	46	55
-1	-8	30	31
-2	-8	30	30
-3	-8	29	29
-4	-8	29	28
-5	-8	50	50
-6	-8	80	80
-7	-8	90	90
-8	-8	115	90
-9	-8	100	165
-10	-8	35	35
-11	-8	45	45
-12	-8	39	38
-13	-8	150	150
-14	-8	33	31
-15	-8	50	56
-16	-8	25	28
-17	-8	35	28
-18	-8	31	38
0	-9	32	41
-1	-9	35	34
-2	-9	34	34
-3	-9	32	31
-4	-9	31	30
-5	-9	33	32
-6	-9	40	38
-7	-9	30	60
-8	-9	125	165
-9	-9	100	90
-10	-9	50	39
-11	-9	65	60
-12	-9	95	120
-13	-9	80	85
-14	-9	65	70
-15	-9	45	35
-16	-9	50	45
-17	-9	60	60
-18	-9	55	55
0	-10	36	36
-1	-10	38	36
-2	-10	35	35
-3	-10	40	33
-4	-10	95	75
-5	-10	36	36
-6	-10	39	29
-7	-10	44	46
-8	-10	90	90
-9	-10	95	90

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	uR/hr Ground
-10	-10	65	50
-11	-10	75	95
-12	-10	40	31
-13	-10	100	115
-14	-10	40	40
-15	-10	29	29
-16	-10	25	23
-17	-10	48	60
-18	-10	45	60
0	-11	45	40
-1	-11	60	50
-2	-11	45	40
-3	-11	65	50
-4	-11	90	90
-5	-11	60	55
-6	-11	60	55
-7	-11	125	155
-8	-11	65	50
-9	-11	90	80
-10	-11	130	130
-11	-11	65	65
-12	-11	33	33
-13	-11	29	29
-14	-11	230	275
-15	-11	22	22
-16	-11	20	20
-17	-11	20	19
-18	-11	18	19
0	-12	39	39
-1	-12	46	46
-2	-12	46	34
-3	-12	114	93
-4	-12	200	214
-5	-12	171	200
-6	-12	93	86
-7	-12	114	129
-8	-12	49	43
-9	-12	186	171
-10	-12	214	243
-11	-12	86	57
-12	-12	31	29
-13	-12	29	26
-14	-12	26	23
-15	-12	19	17
-16	-12	17	17
-17	-12	17	17
-18	-12	14	14
0	-13	39	40
-1	-13	65	55
-2	-13	45	50

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-3	-13	150	700
-4	-13	110	90
-5	-13	190	200
-6	-13	175	200
-7	-13	95	90
-8	-13	85	75
-9	-13	190	185
-10	-13	110	115
-11	-13	30	29
-12	-13	29	29
-13	-13	22	22
-14	-13	20	20
-15	-13	19	19
0	-14	100	86
-1	-14	46	49
-2	-14	100	86
-3	-14	100	86
-4	-14	171	143
-5	-14	314	229
-6	-14	271	214
-7	-14	171	164
-8	-14	60	51
-9	-14	143	157
-10	-14	46	51
-11	-14	171	214
-12	-14	29	29
-13	-14	23	23
-14	-14	20	20
-15	-14	20	20
0	-15	75	75
-1	-15	55	50
-2	-15	65	75
-3	-15	85	85
-4	-15	165	165
-5	-15	160	155
-6	-15	145	140
-7	-15	84	86
-8	-15	47	42
-9	-15	46	40
-10	-15	38	34
-11	-15	28	48
-12	-15	22	22
-13	-15	20	20
-14	-15	18	18
-15	-15	18	18
0	-16	86	86
-1	-16	54	50
-2	-16	100	114
-3	-16	171	264
-4	-16	200	229

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-5	-16	114	93
-6	-16	107	114
-7	-16	171	200
-8	-16	79	54
-9	-16	40	36
-10	-16	40	40
-11	-16	46	34
-12	-16	29	23
-13	-16	20	20
0	-17	38	39
-1	-17	70	110
-2	-17	95	80
-3	-17	100	115
-4	-17	70	55
-5	-17	85	85
-6	-17	135	150
-7	-17	100	85
-8	-17	50	50
-9	-17	55	55
-10	-17	50	50
-11	-17	39	31
-12	-17	23	21
-13	-17	18	18
0	-18	40	40
-1	-18	100	86
-2	-18	214	257
-3	-18	371	600
-4	-18	100	93
-5	-18	100	93
-6	-18	157	171
-7	-18	271	286
-8	-18	57	50
-9	-18	37	31
-10	-18	40	49
-11	-18	114	100
-12	-18	29	23
-13	-18	20	19
0	-19	38	38
-1	-19	125	130
-2	-19	100	90
-3	-19	95	90
-4	-19	65	65
-5	-19	65	70
-6	-19	125	125
-7	-19	85	105
-8	-19	85	100
-9	-19	31	30
-10	-19	28	28
-11	-19	25	24
-12	-19	22	23

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	uR/hr Ground
-13	-19	19	19
0	-20	100	86
-1	-20	129	207
-2	-20	129	150
-3	-20	86	79
-4	-20	100	86
-5	-20	86	71
-6	-20	20	19
-7	-20	114	114
-8	-20	54	60
-9	-20	29	29
0	-21	70	55
-1	-21	80	120
-2	-21	110	115
-3	-21	70	65
-4	-21	44	46
-5	-21	65	65
-6	-21	90	85
-7	-21	48	46
-8	-21	60	60
-9	-21	27	25
0	-22	36	31
-1	-22	49	40
-2	-22	57	100
-3	-22	46	51
-4	-22	31	29
-5	-22	93	157
-6	-22	37	34
-7	-22	40	37
-8	-22	107	93
-9	-22	29	26
0	-23	37	34
-1	-23	35	34
-2	-23	30	29
-3	-23	30	30
-4	-23	29	28
-5	-23	55	50
-6	-23	45	38
-7	-23	75	135
-8	-23	29	31
-9	-23	25	24
0	-24	37	34
-1	-24	29	26
-2	-24	29	27
-3	-24	46	46
-4	-24	51	37
-5	-24	31	31
-6	-24	34	31
-7	-24	34	29
-8	-24	20	20

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-9	-24	21	20
0	-25	26	26
-1	-25	27	28
-2	-25	26	24
-3	-25	30	32
-4	-25	27	26
-5	-25	23	21
-6	-25	21	20
-7	-25	22	21
-8	-25	19	17
-9	-25	16	15
0	-26	23	23
-1	-26	23	23
-2	-26	23	23
-3	-26	23	23
-4	-26	23	23
-5	-26	20	20
-6	-26	20	20
-7	-26	20	17
-8	-26	14	14
	-26	14	14
0	-27	20	19
-1	-27	21	20
-2	-27	22	21
-3	-27	25	23
-4	-27	22	22
-5	-27	23	23
-6	-27	21	22
-7	-27	20	18
-8	-27	33	22
-9	-27	15	14
-4.5	-0.5	86	60
-5.5	-0.5	86	60
-6.5	-0.5	86	60
-13.5	-0.5	71	50
-2.5	-1.5	114	80
-3.5	-1.5	114	80
-4.5	-1.5	129	90
-11.5	-1.5	100	70
-12.5	-1.5	114	80
-13.5	-1.5	71	50
-0.5	-2.5	157	110
-1.5	-2.5	100	70
-2.5	-2.5	114	80
-11.5	-2.5	100	70
-12.5	-2.5	107	75
-9.5	-3.5	86	60
-11.5	-3.5	100	70
-9.5	-4.5	86	60
-10.5	-4.5	100	70

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

		uR/hr	
West	South	Waist	Ground
-14.5	-4.5	157	110
-7.5	-6.5	57	40
-9.5	-6.5	43	30
-13.5	-6.5	86	60
-14.5	-6.5	100	70
-4.5	-7.5	79	55
-5.5	-7.5	79	55
-6.5	-7.5	114	80
-7.5	-7.5	157	110
-8.5	-7.5	100	70
-9.5	-7.5	71	50
-11.5	-7.5	57	40
-13.5	-7.5	100	70
-14.5	-7.5	57	40
-5.5	-8.5	79	55
-7.5	-8.5	121	85
-8.5	-8.5	129	90
-9.5	-8.5	57	40
-11.5	-8.5	86	60
-12.5	-8.5	100	70
-13.5	-8.5	57	40
-14.5	-8.5	43	30
-3.5	-9.5	71	50
-6.5	-9.5	50	35
-7.5	-9.5	50	35
-8.5	-9.5	121	85
-9.5	-9.5	46	32
-10.5	-9.5	71	50
-11.5	-9.5	86	60
-0.5	-10.5	100	70
-1.5	-10.5	100	70
-2.5	-10.5	71	50
-3.5	-10.5	93	65
-4.5	-10.5	57	40
-5.5	-10.5	43	30
-6.5	-10.5	114	80
-7.5	-10.5	143	100
-8.5	-10.5	129	90
-9.5	-10.5	114	80
-13.5	-10.5	286	200
-14.5	-10.5	286	200
-0.5	-11.5	43	30
-1.5	-11.5	57	40
-2.5	-11.5	129	90
-3.5	-11.5	186	130
-4.5	-11.5	71	50
-5.5	-11.5	57	40
-6.5	-11.5	50	35
-8.5	-11.5	129	90
-9.5	-11.5	164	115

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	uR/hr Waist	Ground
-10.5	-11.5	71	50
-13.5	-11.5	286	200
-14.5	-11.5	286	200
-17.5	-11.5	57	40
-1.5	-12.5	57	40
-2.5	-12.5	186	130
-3.5	-12.5	154	108
-7.5	-12.5	143	100
-8.5	-12.5	171	120
-9.5	-12.5	164	115
-11.5	-12.5	57	40
-0.5	-13.5	43	30
-1.5	-13.5	179	125
-3.5	-13.5	171	120
-5.5	-13.5	186	130
-6.5	-13.5	371	260
-7.5	-13.5	371	260
-9.5	-13.5	93	65
-10.5	-13.5	114	80
-11.5	-13.5	100	70
-2.5	-14.5	243	170
-3.5	-14.5	200	140
-4.5	-14.5	229	160
-5.5	-14.5	271	190
-6.5	-14.5	171	120
-9.5	-14.5	114	80
-0.5	-15.5	1714	1200
-1.5	-15.5	514	360
-2.5	-15.5	486	340
-3.5	-15.5	314	220
-4.5	-15.5	286	200
-5.5	-15.5	343	240
-6.5	-15.5	857	600
-7.5	-15.5	243	170
-8.5	-15.5	186	130
-10.5	-15.5	514	360
-2.5	-16.5	240	
-3.5	-16.5	410	
-6.5	-16.5	750	
-7.5	-16.5	175	
-10.5	-16.5	300	
-0.5	-17.5	714	500
-1.5	-17.5	714	500
-2.5	-17.5	343	240
-3.5	-17.5	1429	1000
-4.5	-17.5	186	130
-5.5	-17.5	1143	800
-6.5	-17.5	536	375
-7.5	-17.5	286	200
-8.5	-17.5	314	220

Nanabah-Vandever Site, Section 24
Pre-Remediation Survey, August, 1991

West	South	Waist uR/hr	Ground uR/hr
-9.5	-17.5	286	200
-10.5	-17.5	286	200
-11.5	-17.5	500	350
-0.5	-18.5	430	
-1.5	-18.5	250	
-3.5	-18.5	2300	
-4.5	-18.5	900	
-5.5	-18.5	850	
-6.5	-18.5	1000	
-7.5	-18.5	1200	
-11.5	-18.5	210	
-0.5	-19.5	429	300
-1.5	-19.5	857	600
-2.5	-19.5	371	260
-4.5	-19.5	200	140
-5.5	-19.5	1357	950
-6.5	-19.5	357	250
-8.5	-19.5	286	200
-2.5	-20.5	175	
-7.5	-20.5	210	
-8.5	-20.5	1000	
-0.5	-21.5	600	420
-1.5	-21.5	1429	1000
-2.5	-21.5	200	140
-4.5	-21.5	186	130
-8.5	-21.5	257	180
-1.5	-22.5	950	
-7.5	-22.5	1700	
-6.5	-23.5	514	360
-2.5	-24.5	125	
	Avg Gamma	118.16 uR/hr	

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-9	-1	30
-10	-1	20
-11	-1	18
-12	-1	18
-13	-1	15
-14	-1	20
-15	-1	18
-16	-1	27
-17	-1	18
-18	-1	18
-8	-2	24
-9	-2	20
-10	-2	18
-11	-2	16
-12	-2	16
-13	-2	20
-14	-2	32
-15	-2	56
-16	-2	20
-17	-2	18
-18	-2	14
-8	-3	24
-9	-3	28
-10	-3	27
-11	-3	20
-12	-3	18
-13	-3	18
-14	-3	30
-15	-3	30
-16	-3	21
-17	-3	14
-18	-3	12
0	-4	26
-1	-4	24
-2	-4	22
-3	-4	28
-4	-4	25
-5	-4	28
-6	-4	22
-7	-4	18
-8	-4	22
-9	-4	24
-10	-4	41
-11	-4	40
-12	-4	18
-13	-4	18
-14	-4	24
-15	-4	22
-16	-4	16
-17	-4	12

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-18	-4	12
0	-5	22
-1	-5	20
-2	-5	20
-3	-5	36
-4	-5	20
-5	-5	22
-6	-5	24
-7	-5	36
-8	-5	46
-9	-5	56
-10	-5	50
-11	-5	22
-12	-5	24
-13	-5	20
-14	-5	18
-15	-5	20
-16	-5	14
-17	-5	12
-18	-5	14
0	-6	24
-1	-6	20
-2	-6	20
-3	-6	32
-4	-6	24
-5	-6	23
-6	-6	26
-7	-6	30
-8	-6	24
-9	-6	34
-10	-6	42
-11	-6	20
-12	-6	34
-13	-6	22
-14	-6	20
-15	-6	20
-16	-6	14
-17	-6	12
-18	-6	14
0	-7	23
-1	-7	20
-2	-7	20
-3	-7	20
-4	-7	20
-5	-7	26
-6	-7	40
-7	-7	30
-8	-7	36
-9	-7	24
-10	-7	38

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-11	-7	42
-12	-7	24
-13	-7	39
-14	-7	28
-15	-7	22
-16	-7	18
-17	-7	24
-18	-7	14
0	-8	28
-1	-8	26
-2	-8	22
-3	-8	18
-4	-8	18
-5	-8	20
-6	-8	30
-7	-8	30
-8	-8	34
-9	-8	24
-10	-8	24
-11	-8	34
-12	-8	44
-13	-8	34
-14	-8	24
-15	-8	20
-16	-8	20
-17	-8	22
-18	-8	14
0	-9	22
-1	-9	24
-2	-9	20
-3	-9	20
-4	-9	18
-5	-9	20
-6	-9	22
-7	-9	24
-8	-9	32
-9	-9	40
-10	-9	22
-11	-9	50
-12	-9	26
-13	-9	32
-14	-9	16
-15	-9	18
-16	-9	34
-17	-9	36
-18	-9	40
0	-10	28
-1	-10	18
-2	-10	20
-3	-10	20

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-4	-10	24
-5	-10	38
-6	-10	50
-7	-10	26
-8	-10	28
-9	-10	30
-10	-10	38
-11	-10	32
-12	-10	36
-13	-10	20
-14	-10	18
-15	-10	20
-16	-10	42
-17	-10	32
-18	-10	34
0	-11	26
-1	-11	24
-2	-11	20
-3	-11	26
-4	-11	32
-5	-11	46
-6	-11	40
-7	-11	40
-8	-11	32
-9	-11	56
-10	-11	36
-11	-11	22
-12	-11	20
-13	-11	18
-14	-11	24
-15	-11	20
0	-12	26
-1	-12	22
-2	-12	22
-3	-12	30
-4	-12	32
-5	-12	46
-6	-12	46
-7	-12	36
-8	-12	50
-9	-12	44
-10	-12	32
-11	-12	20
-12	-12	18
-13	-12	14
0	-13	26
-1	-13	26
-2	-13	24
-3	-13	26
-4	-13	24

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-5	-13	44
-6	-13	55
-7	-13	50
-8	-13	36
-9	-13	34
-10	-13	36
-11	-13	20
-12	-13	22
-13	-13	14
0	-14	42
-1	-14	28
-2	-14	44
-3	-14	28
-4	-14	44
-5	-14	30
-6	-14	44
-7	-14	56
-8	-14	32
-9	-14	22
-10	-14	16
-11	-14	22
-12	-14	20
-13	-14	16
0	-15	55
-1	-15	26
-2	-15	36
-3	-15	23
-4	-15	50
-5	-15	56
-6	-15	50
-7	-15	50
-8	-15	42
-9	-15	30
-10	-15	28
-11	-15	26
-12	-15	18
-13	-15	14
0	-16	32
-1	-16	26
-2	-16	44
-3	-16	24
-4	-16	56
-5	-16	50
-6	-16	46
-7	-16	40
-8	-16	24
-9	-16	26
-10	-16	20
-11	-16	14
-12	-16	14

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
-13	-16	12
0	-17	32
-1	-17	30
-2	-17	40
-3	-17	24
-4	-17	36
-5	-17	55
-6	-17	50
-7	-17	40
-8	-17	34
-9	-17	24
-10	-17	26
-11	-17	16
-12	-17	16
-13	-17	10
0	-18	22
-1	-18	32
-2	-18	38
-3	-18	26
-4	-18	48
-5	-18	56
-6	-18	56
-7	-18	50
-8	-18	24
-9	-18	18
-10	-18	20
-11	-18	18
-12	-18	12
0	-19	26
-1	-19	50
-2	-19	30
-3	-19	42
-4	-19	46
-5	-19	44
-6	-19	40
-7	-19	50
-8	-19	22
-9	-19	18
-10	-19	14
-11	-19	12
0	-20	80
-1	-20	30
-2	-20	34
-3	-20	22
-4	-20	32
-5	-20	56
-6	-20	30
-7	-20	30
-8	-20	18
-9	-20	16

Nanabah-Vandever Site, Section 24
Post-Remediation Survey, August, 1991

West	South	Waist uR/hr
0	-21	26
-1	-21	26
-2	-21	36
-3	-21	20
-4	-21	36
-5	-21	50
-6	-21	30
-7	-21	24
-8	-21	24
-9	-21	14
0	-22	24
-1	-22	22
-2	-22	20
-3	-22	22
-4	-22	26
-5	-22	24
-6	-22	50
-7	-22	34
-8	-22	20
-9	-22	14
0	-23	28
-1	-23	28
-2	-23	24
-3	-23	22
-4	-23	34
-5	-23	50
-6	-23	36
-7	-23	16
-8	-23	30
-9	-23	10
	Avg Gamma	28.19 uR/hr

Brown-Vandever Site, Section 18
Pre-Remediation Survey, August, 1991

West	North	uR/hr Waist	uR/hr Ground
-4	0	33	26
-3	0	100	120
-2	0	30	32
-1	0	32	31
0	0	75	60
-4	1	32	27
-3	1	33	32
-2	1	33	32
-1	1	40	42
0	1	125	120
1	1	40	40
2	1	30	26
-4	2	25	25
-3	2	28	28
-2	2	38	35
-1	2	60	55
0	2	100	145
1	2	75	60
2	2	42	44
3	2	30	27
4	2	24	24
-4	3	25	25
-3	3	60	60
-2	3	80	115
-1	3	85	75
0	3	130	140
1	3	70	60
2	3	100	110
3	3	110	85
4	3	38	28
5	3	27	25
-4	4	60	75
-3	4	65	75
-2	4	95	100
-1	4	110	125
0	4	65	50
1	4	105	105
2	4	110	120
3	4	280	350
4	4	300	370
5	4	32	32
-4	5	38	29
-3	5	35	38
-2	5	65	55
-1	5	85	75
0	5	42	42
1	5	55	55
2	5	70	70
3	5	420	600
4	5	170	80

Brown-Vandever Site, Section 18
Pre-Remediation Survey, August, 1991

		uR/hr	
West	North	Waist	Ground
-4	6	22	21
-3	6	24	25
-2	6	75	65
-1	6	70	105
0	6	75	70
1	6	115	120
2	6	100	115
3	6	250	240
4	6	280	300
5	6	380	500
-4	7	23	23
-3	7	26	26
-2	7	85	85
-1	7	550	600
0	7	850	800
1	7	380	450
2	7	90	95
3	7	270	290
4	7	250	330
5	7	240	250
-4	8	22	21
-3	8	25	26
-2	8	80	75
-1	8	350	380
0	8	170	125
1	8	80	65
2	8	100	115
3	8	80	80
4	8	130	100
5	8	60	50
-4	9	21	21
-3	9	24	25
-2	9	27	26
-1	9	38	39
0	9	36	38
1	9	70	90
2	9	240	300
3	9	160	220
4	9	200	200
5	9	40	36
-4	10	19	19
-3	10	25	24
-2	10	25	23
-1	10	28	28
0	10	34	33
1	10	65	50
2	10	280	350
3	10	130	130
4	10	160	170
5	10	32	32

Brown-Vandever Site, Section 18
Pre-Remediation Survey, August, 1991

West	North	uR/hr Waist	Ground
-4	11	19	19
-3	11	20	20
-2	11	20	20
-1	11	25	25
0	11	37	36
1	11	150	160
2	11	36	30
3	11	210	250
4	11	75	50
-4	12	19	18
-3	12	19	19
-2	12	20	20
-1	12	22	23
0	12	29	27
1	12	26	25
2	12	50	50
3	12	24	24
4	12	25	24
-4	13	18	17
-3	13	19	19
-2	13	19	18
-1	13	20	19
0	13	24	22
1	13	24	22
2	13	24	20
3	13	18	16
4	13	22	20
6	6	40	32
6	7	35	30
-5	5	20	21

Avg Gamma 92.05 uR/hr

Brown-Vandever Site, Section 18
Post-Remediation Survey, August, 1991

West	North	Waist uR/hr
-4	0	18
-3	0	12
-2	0	18
-1	0	10
0	0	20
-4	1	12
-3	1	12
-2	1	15
-1	1	16
0	1	20
1	1	15
2	1	18
-4	2	12
-3	2	12
-2	2	12
-1	2	16
0	2	14
1	2	12
2	2	14
3	2	12
4	2	12
5	2	12
-4	3	10
-3	3	20
-2	3	14
-1	3	10
0	3	12
1	3	12
2	3	14
3	3	12
4	3	12
5	3	14
6	3	12
-5	4	12
-4	4	12
-3	4	16
-2	4	12
-1	4	10
0	4	10
1	4	14
2	4	12
3	4	16
4	4	12
5	4	12
6	4	14
-4	5	18
-3	5	12
-2	5	10
-1	5	12
0	5	12

Brown-Vandever Site, Section 18
Post-Remediation Survey, August, 1991

West	North	Waist uR/hr
1	5	12
2	5	14
3	5	14
4	5	12
5	5	16
-4	6	12
-3	6	12
-2	6	10
-1	6	12
0	6	10
1	6	12
2	6	12
3	6	12
4	6	12
5	6	16
-5	7	14
-4	7	12
-3	7	16
-2	7	34
-1	7	14
0	7	12
1	7	12
2	7	12
3	7	12
4	7	12
5	7	12
-6	8	14
-5	8	12
-4	8	12
-3	8	12
-2	8	12
-1	8	16
0	8	10
1	8	12
2	8	12
3	8	12
4	8	12
5	8	12
-4	9	14
-3	9	12
-2	9	12
-1	9	12
0	9	12
1	9	12
2	9	12
3	9	12
4	9	12
5	9	12
-4	10	10
-3	10	12

Brown-Vandever Site, Section 18
Post-Remediation Survey, August, 1991

West	North	Waist uR/hr
-2	10	14
-1	10	10
0	10	12
1	10	12
2	10	12
3	10	12
4	10	12
5	10	18
-4	11	12
-3	11	10
-2	11	12
-1	11	12
0	11	14
1	11	12
2	11	10
3	11	14
4	11	12
-4	12	12
-3	12	12
-2	12	12
-1	12	12
0	12	10
1	12	12
2	12	12
3	12	12
4	12	12
-4	13	12
-3	13	12
-2	13	12
-1	13	10
0	13	10
1	13	14
2	13	12
3	13	12
4	13	12
6	6	12
6	7	12
-5	5	12
	Avg Gamma	12.84 uR/hr

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
19	34	30	50
18	36	20	30
15.5	34.5	10	10
15	37	30	
14.5	39	100	200
14.5	40	10	20
13	41	200	500
12	41	200	400
5.5	34.5	200	380
5.25	34.25	200	400
5	34.1	300	500
4.6	33.7	300	500
4	33.8	500	800
11	36	10	50
12	36	500	500
12	36.8	170	200
12	37.5	250	600
12	39	310	1000
12	40	40	48
12.7	39	110	250
12.7	37	180	400
12.7	36.1	130	110
12.7	34.5	310	380
13.5	31	100	130
13	30	100	110
13.8	30	80	80
11.5	29.5	130	130
11	32	250	800
11.5	33	110	110
10	28.6	300	1500
6	26.8	250	500
6.9	26.8	400	3000
7.3	26.3	300	300
6.8	25.9	50	50
5.8	25.9	30	30
5	25	25	25
5.2	22.5	28	28
6	21	20	20
7	20	30	30
7.5	19	32	32
9	19	120	300
9.1	17.9	50	50
10	18	50	50
10.5	18.1	100	800
10.5	18.9	50	50
10	19.4	35	35
9.2	20.3	35	35
9	19.8	30	30
8.4	20.4	30	30
8.6	21.1	38	38

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
6.9	22.5	30	30
6.7	24.3	50	50
6.8	25.1	80	80
7.1	25.1	110	170
11.1	22.5	100	100
11.2	21	150	150
12.8	19.9	100	100
13.3	18.2	110	110
16.2	25.5	100	300
16.5	25.3	350	
15.5	24		150
16.5	23.3	350	
14.3	22.3	35	35
14	21.5	50	50
13.3	23.3	100	100
14	21	50	50
12.5	21.9	75	75
13	20.5	135	140
13.6	20	65	65
14	16.5	600	2000
7.7	17.5	24	24
5.4	14.1	35	35
5.8	13.9	50	70
5.2	13.6	35	35
4.9	13.2	35	35
4.1	11.7	28	28
4.8	11.7	25	25
3	9.2	60	500
3.3	7.9	40	70
3.8	8	60	100
4.2	9.5	35	35
4.5	7.2	35	35
7.3	7.1	50	50
7.8	6.9	50	400
8.5	5.6	35	35
9.2	5.3	40	75
9.5	5.2	50	50
10	5	65	750
11.5	6	30	30
11.85	6.5	75	300
9.9	6.6	45	45
9.2	7.5	50	50
8.7	7.8	75	75
7	7.8	45	45
6.3	8	35	35
7.4	9.2	50	50
6.2	9.4	50	50
5.3	10	130	1000
4.8	9.3	35	35
25	26.2	23	

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
24.5	25.9	23	
24	26	29	
23.8	25.1	36	
24.1	25.1	43	
21.2	25.9	86	
19.1	25.9	43	
18	26.1	107	
17.4	25.5	129	
17.6	24.7	200	
18.8	25.1	114	
17.3	23.2	43	
20.2	24.8	100	
20.8	24.2	100	
21.5	23.9	40	
22.8	23.3	43	
22.4	22.5	107	
22	22.5	157	
21.3	22.5	171	
22	23	157	
20.9	23	34	
21.1	22.1	114	
21.7	22	114	
22.2	22	129	
23.1	22	71	
23.7	23.2	21	
22.9	21.1	114	
22.5	21.4	171	
21.8	22.2	157	
21	21.6	86	
20.4	22.2	34	
20.3	23.1	34	
19.9	22.9	34	
19.2	23.9	37	
18.5	23.3	34	
18	22.6	34	
18	23.5	34	
21	25.2	43	
22.3	24.3	46	
22.5	20.6	31	
20.3	21	143	
20.2	21.5	157	
20	21.2	31	
18.7	21.3	29	
17	21.6	40	
16.6	22.4	57	
15.5	21.6	343	
15	21.6	86	
16.7	21	86	
17	20.6	186	
17.1	20.2	214	

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
17	19.4	157	
17.7	19.5	37	
18.7	20.6	29	
18.4	19.6	31	
19.3	17.3	29	
20.1	18.1	114	
20.2	18.6	200	
20.8	18.5	314	
21.3	18.9	271	
20.2	19.1	286	
20.6	19.5	143	
20.1	19.5	143	
21.6	18.6	236	
21.2	17.7	300	
20.7	17.6	200	
21.7	18.1	200	
21.4	17.6	214	
21.7	18	157	
21.8	17.8	26	
21.7	18.9	193	
21.9	20	26	
20.2	15.1	26	
18.6	14	49	
18	14.5	100	
18.3	16.1	29	
17.8	17	46	
17.4	18.5	186	
17	18.8	157	
16.7	18.3	143	
17	18.5	143	
17.1	17.8	329	
16.5	17.3	171	
16	18.5	343	
15.7	18	314	
15.5	18.6	214	
15.3	19.1	214	
16.4	19	186	
16.5	19.4	214	
16	19.3	214	
16.2	20	229	
15.5	20.2	221	
14.8	19.6	214	
17	17	129	
15.6	16.5	357	
14.9	16.1	629	
15.3	15.1	1143	
14.8	13.8	429	
16	13.4	1000	
16.7	12	429	
14.2	15.2	71	

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
15	12.5	314	
15	11.6	100	
14.8	10.8	314	
16.3	11	571	
18.2	10	37	
19.6	8.8	300	
20	10	286	
20.3	11.1	186	
20.7	12	214	
22	10	21	
18	6.8	26	
16.9	4.5	24	
15.3	6.2	100	
15.1	7.2	157	
16.2	9.1	51	
15.6	8.5	214	
14.7	9.5	66	
12.5	6.2	31	
13.9	4.9	129	
14.7	4.7	200	
14.2	3.6	114	
11.2	4	57	
11.9	2.1	86	
13.5	3	121	
11.2	1.1	64	
13	0.6	37	
14.6	0.8	23	
10	2	30	
9.3	0.6	23	
23.8	30.7	21	21
22.9	28.3	29	29
22	28	43	43
21.6	28.7	43	57
21.9	29.6	21	21
21.6	31.9	43	43
20	32	29	29
19.7	30	71	71
20.4	28.3	143	371
21	27	257	371
22.8	27.1	71	71
22	26.3	100	186
21	26.2	171	329
19.7	26.4	71	71
19.2	27.7	34	34
19.2	29	43	26
19.1	30.9	29	29
19.3	32.9	29	31
20.5	33.3	20	20
17.7	30.5	29	26
16.6	29.2	29	34

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
18.2	28.5	29	29
16.7	28	26	26
15	28.1	46	40
14.4	27.3	43	37
13.9	27	71	71
14.4	26.2	54	57
15.7	27.2	69	46
15	27.3	97	114
12.6	26.8	214	457
12.8	25.1	71	71
12	25.8	43	34
11.2	25.7	71	71
11.5	26.6	143	143
11.9	24.3	46	40
10.4	25.5	214	429
9.5	25.5	143	186
10	26.5	186	214
7.1	26	200	171
8.9	26.8	86	71
9.2	24.8	214	171
11	24.4	457	2857
8.1	25.5	43	43
9.1	22.8	100	71
8.9	21.2	37	29
10.3	22.2	71	86
9.5	20.8	57	54
8.9	21.1	37	40
8	23.5	43	43
9.2	23.9	57	51
13.7	14.3	46	46
13.2	16.2	63	57
13.2	17.6	257	857
12.1	17.7	71	71
10.4	17.3	34	29
9.4	17.3	34	31
8.8	18.2	36	31
7.5	17.8	36	31
7.1	16.6	21	21
8.4	17.2	23	23
8.2	15.8	26	26
8.3	14.5	31	29
9.5	14.2	43	29
10	16	29	29
11	15.2	34	31
11.1	14.1	43	31
11.4	12.6	37	29
12.6	12.1	43	36
12.8	13.9	36	31
13.8	13.1	143	286
13.9	10.9	37	40

Desiderio Site
Pre-Remediation Survey, August, 1991

		uR/hr	
South	West	Waist	Ground
12	9.8	66	79
11.5	9	186	371
10.3	8.2	57	36
9.7	9.6	143	100
8.2	11	257	257
8	12.3	286	514
7	12	343	457
6.4	13.8	34	34
9.5	12.9	243	286
10.2	12.1	429	543
10.5	11	229	157
11.2	9.8	51	34
12.5	10.3	36	34
13	8.5	86	200
10.6	7.5	49	39
9	8	429	3429
8.8	7.8	100	321
9.1	6.6	71	86
10.2	6.5	57	49
	Avg Gamma	122.93 uR/hr	

Desiderio Site
Post-Remediation Survey, September, 1991

Pre-Remediation Grid		Waist	Post-Remediation Grid	
South	West	uR/hr	North	East
24.7	32.1	11	N0	E0
24.2	29.9	39	N0	E1
23.6	27.6	12	N0	E2
23.1	25.4	11	N0	E3
22.5	23.1	11	N0	E4
22.0	20.9	14	N0	E5
21.4	18.6	14	N0	E6
20.9	16.4	12	N0	E7
20.3	14.1	13	N0	E8
19.8	11.9	13	N0	E9
19.2	9.6	13	N0	E10
18.7	7.4	15	N0	E11
22.4	32.6	17	N1	E0
21.9	30.4	13	N1	E1
21.3	28.1	14	N1	E2
20.8	25.9	12	N1	E3
20.3	23.7	12	N1	E4
19.7	21.4	15	N1	E5
19.2	19.2	12	N1	E6
18.6	16.9	12	N1	E7
18.1	14.7	14	N1	E8
17.5	12.4	19	N1	E9
17.0	10.2	40	N1	E10
16.4	7.9	22	N1	E11
20.2	33.2	12	N2	E0
19.6	30.9	11	N2	E1
19.1	28.7	13	N2	E2
18.5	26.4	17	N2	E3
18.0	24.2	13	N2	E4
17.4	21.9	12	N2	E5
16.9	19.7	11	N2	E6
16.3	17.4	12	N2	E7
15.8	15.2	14	N2	E8
15.3	13.0	16	N2	E9
14.7	10.7	18	N2	E10
14.2	8.5	28	N2	E11
17.9	33.7	15	N3	E0
17.4	31.5	22	N3	E1
16.8	29.2	12	N3	E2
16.3	27.0	11	N3	E3
15.7	24.7	15	N3	E4
15.2	22.5	11	N3	E5
14.6	20.2	12	N3	E6
14.1	18.0	10	N3	E7
13.5	15.7	50	N3	E8
13.0	13.5	18	N3	E9
12.4	11.2	14	N3	E10
11.9	9.0	25	N3	E11
15.6	34.2	12	N4	E0

Desiderio Site
Post-Remediation Survey, September, 1991

Pre-Remediation Grid		Waist	Post-Remediation Grid	
South	West	uR/hr	North	East
15.1	32.0	13	N4	E1
14.5	29.7	13	N4	E2
14.0	27.5	12	N4	E3
13.5	25.3	17	N4	E4
12.9	23.0	12	N4	E5
12.4	20.8	12	N4	E6
11.8	18.5	11	N4	E7
11.3	16.3	20	N4	E8
10.7	14.0	30	N4	E9
10.2	11.8	30	N4	E10
9.6	9.5	14	N4	E11
13.4	34.8	12	N5	E0
12.8	32.5	15	N5	E1
12.3	30.3	13	N5	E2
11.7	28.0	14	N5	E3
11.2	25.8	11	N5	E4
10.6	23.5	12	N5	E5
10.1	21.3	11	N5	E6
9.5	19.0	14	N5	E7
9.0	16.8	18	N5	E8
8.5	14.6	14	N5	E9
7.9	12.3	18	N5	E10
7.4	10.1	13	N5	E11
11.1	35.3	15	N6	E0
10.6	33.1	25	N6	E1
10.0	30.8	32	N6	E2
9.5	28.6	15	N6	E3
8.9	26.3	11	N6	E4
8.4	24.1	12	N6	E5
7.8	21.8	10	N6	E6

Avg Gamma 15.86 uR/hr

APPENDIX C
AIRBORNE DUST MEASUREMENTS
BLUEWATER URANIUM
TRIP REPORT
AUGUST 12 - SEPTEMBER 19, 1991

Aerosol Particulate Monitoring at the Bluewater Uranium Mine Site

EPA Region IX, assisted by EPA/ERT and REAC is conducting a removal action at several areas of the Vandever and Desiderio mine sites near Prewitt, NM. As a result of earth moving operations to cover certain strip-mined areas, the potential exists for resuspension of higher than ambient concentrations of uranium and/or radium. From analysis of previous samples taken at these sites, using the maximum detected concentrations of each isotope, it was calculated that, for Class W lung retention and a 60 hour work week, a dust concentration of 170 micrograms per liter (ug/L) would result in a dose of 100 millirem per week (mrem/wk). In order to protect the workers, a criterion of "visible dust" was established for Level C respiratory protection. If "visible dust" (or, about 10 ug/L) is present, all unprotected personnel must go to Level C respiratory protection.

In order to better quantify dust concentrations present at locations of interest, a model RAM-1 real-time aerosol monitor was used. This instrument, S/N 1727, calibrated at REAC on 7/28/91, was manufactured by MIE (Monitoring Instruments for the Environment, Inc.) of Bedford, Massachusetts. The RAM-1 is a portable, self-contained aerosol monitor whose sensing principle is based on the detection of near-forward scattered infrared radiation. The instrument uses a gallium arsenide semiconductor which generates EM radiation at 940 nanometers (nm) wavelength. The scattered radiation is detected by means of a silicon photo-voltaic type diode with an integral low-noise preamplifier. The instrument has three selectable ranges [0-2, 0-20, and 0-200 mg/m^3 (= ug/L)]. In addition, there are four operator-selectable response-time constants (0.5, 2, 8 and 32 seconds). The air flow-rate for sampling is 2 L/min, and for flushing with clean air is 0.2 L/min. After being fully charged, the instrument is designed to operate continuously for 6 to 8 hours.

The following table summarizes aerosol particulate data obtained at the Brown Vandever site (beginning 8/20/91), and at the Desiderio site (beginning 9/3/91).

The response time constant for the measurements was usually 2 seconds. With the exception of the time a car passed within 4 feet of the instrument, the maximum airborne dust concentration measured was 0.371 ug/L. If breathed at that concentration continuously (60 hours per week) for a year with the maximum concentrations previously measured of uranium and radium, a 50-year committed effective dose equivalent (cede) of 10.9 mrem would result.

$$[\text{cede} = (5000/170) \times (C_{max}) = 29.41\ C_{max}]$$

$$\text{cede}_{50\ yr}\ (\text{mrem}) = 29.41\ C_{max}\ (\text{ug/L})$$

where,

C_{max} = Dust Concentration in ug/L

Over the period from 08/20/91 through 09/17/91, a total of 41 dust concentration measurements for a total of 309 minutes were made on 18 different days at a variety of locations on the Vandever and Desiderio mine sites. The total time-weighted dust concentration over the entire study was .011 ug/L, which, if breathed continuously for 60 hours per week and 50 weeks per year at maximum previously-measured uranium and radium concentrations, would result in a committed effective dose equivalent (cede) of 0.32 mrem.

G. L. Gels
09/25/91

Table 1

Date	Time	Location	Zero	Cal.	Measurement Time	Concentration Range, ug/L		
VANDEVER								
08/20	08:50	HP checkpoint	-.000	2.50	5 min	to .006 ug/L		
	09:20	30-200 m N of dozers	--	----	3	to .007		
	09:40	50-150 m N of dozers	-.004	----	3	.000 to .016		
	11:45	HP cp, downwind	-.000	2.50	2	to .004		
	16:37	HP cp, upwind	-.000	----	3	.003 to .012		
08/21	08:50	100-200m dnwnd of dzers	-.000	----	2	.006 to .012		
	09:10	"	.002	----	3	.008 to .016		
	10:50	HP cp	-.000	----	4	.003 to .006		
	15:27	30-200 m dnwnd of dzers	-.000	----	5	.000 to .005		
	15:49	HP cp	-.000	----	2	.000 to .006		
	15:51	HP cp. Car passes-4 ft	---	----	0.5	.002 to .623 to .003		
08/22	09:00	HP cp dwnwnd	-.000	2.50	5	.003 to .006		
	14:30	200-500 m S of dozers	-.000	2.50	10	.001 to .013		
08/23	09:00	HP cp	-.000	2.50	6	.003 to .005		
	14:32	HP cp	-.000	2.50	8	.003 to .005		
08/24	08:59	HP cp, Sec 24, Brwn-Van	-.000	2.50	7	.001 to .007		
						MIN	MAX	AVG
	09:17	75 m NW of dozer	-.000 to -.004	----	12	.000	.023	.006
	09:40	SW sector of Sec 24	-.000	2.50	5	.002	.005	.003
08/26	08:58	HP cp	-.000	2.50	10	.008	.208	.012
	14:08	HP cp	-.000	----	4	.004	.013	.009
	15:43	HP cp VERY windy (thunderstorm)	-.001	----	8	.005	.371	.040
08/28	13:20	HP cp	-.000	2.50	5	.002	.008	.005
DESIDERIO								
09/03	10:55	HP cp	-.000	2.50	5	.002	.004	.003
09/04	10:10	HP cp	-.000	2.50	5	.003	.006	.005
	15:10	SW of pit	-.000	----	5	.000	.000	.000
	15:20	North side of NE pit	-.000	----	5	.003	.042	.022
09/07	17:05	HP cp	-.000	2.50	5	.010	.170	.026
09/09	15:30	HP cp, 25 m downwind of loader	-.000	2.50	30	.003	.174	.030
09/10	09:06	HP cp, dozer 75 m upwnd	-.000	2.49	10	.003	.015	.009
	13:50	HP cp dozer near	-.000	----	12	.000	.058	.011
09/11	07:50	HP cp	-.000	2.50	10	.008	.011	.009
	15:25	HP cp	-.001	----	10	.002	.141	.004
09/12	08:25	HP cp	-.000	2.50	10	.004	.040	.008
	14:05	HP cp	-.000	----	10	.000	.071	.005
09/13	11:30	HP cp	-.000	2.50	15	.000	.015	.004
	15:45	HP cp	-.000	----	10	.000	.006	.002
09/14	10:55	HP cp	-.000	2.50	7	.003	.006	.005
	16:55	HP cp	-.000	----	5	.002	.004	.003
09/16	08:30	HP cp, dozer 100m upwnd	-.000	2.49	15	.003	.045	.010
	13:40	HP cp, dozer 50-100 m upwind	-.000	----	10	.003	.257	.035
09/17	11:15	HP cp	-.000	2.50	10	.004	.014	.008
	14:35	HP cp	-.000	----	8	.002	.007	.005

Table 2
Bluewater Uranium
Average Dust Concentration Calculation

DATE	MEASUREMENT TIME (MIN)	AVG DUST CONC (ug/L)
08/20/91	5	0.004
	3	0.005
	3	0.008
	2	0.003
	3	0.008
08/21/91	2	0.009
	3	0.012
	4	0.005
	5	0.003
	2	0.003
08/22/91	5	0.005
	10	0.007
08/23/91	6	0.004
	8	0.004
08/24/91	7	0.005
	12	0.006
	5	0.003
08/26/91	10	0.012
	4	0.009
	8	0.04
08/28/91	5	0.005
09/03/91	5	0.003
09/04/91	5	0.005
	5	0
	5	0.022
09/07/91	5	0.026
09/09/91	30	0.03
09/10/91	10	0.009
	12	0.011
09/11/91	10	0.009
	10	0.004
09/12/91	10	0.008
	10	0.005
09/13/91	15	0.004
	10	0.002
09/14/91	7	0.005
	5	0.003
09/16/91	15	0.01
	10	0.035
09/17/91	10	0.008
	8	0.005
TOTAL:	309	

AVERAGE TIME-WEIGHTED
DUST CONCENTRATION: 0.01091

APPENDIX D
INDOOR RADON AT BLUEWATER SITES
BLUEWATER URANIUM
TRIP REPORT
AUGUST 12 - SEPTEMBER 19, 1991

INDOOR RADON AT VANDEVER AND DESIDERIO MINE SITES

There is some concern about indoor radon concentrations at the Vandever and Desiderio uranium mine sites (the Bluewater Mine Sites) near Prewitt, New Mexico. Strip mining operations occurred at both of these locations in the past, indicating that relatively rich uranium deposits lie fairly close to the surface and in close proximity to the home sites.

Two questions need to be answered at these locations: (1) How do indoor concentrations measured at these two sites compare with concentrations measured elsewhere? And, (2) Is it either likely or possible that past mining operations have adversely affected the radon concentrations indoors?

To answer the first question, it has been reported that a concentration of 4.6 pCi/L has been measured at one of the homes at the Desiderio Site, as well as concentrations between 1.5 and 3.3 pCi/L at other homes on site. These measurements were taken with alpha track detectors left in place for two to three months. The results reported at the mine sites are typical for this area (IHS survey, January, 1990,) and in most areas of the country. In the immediate Bluewater area, thirteen homes were measured in the IHS survey, ranging from <1.0 to 7.5 pCi/L, with the average being 2.5 pCi/L. As another point of comparison, a survey in North Dakota showed average radon concentrations of about 6 pCi/L. The conclusion is that there seems to be nothing unusual about the results reported at the two mine sites.

Is it likely, or even possible, that past mining operations have affected indoor concentrations at these sites? The source of indoor radon is the soil in direct proximity to the home. The distance that radon can travel before it decays is directly related to the soil porosity and inversely related to the moisture content. The two mine sites contain a soil horizon composed of fine to coarse grain sand and weathered limestone. The soil porosity is high and the moisture content is low. Therefore, the soil possesses very good soil gas diffusion characteristics. However, since the mean diffusion path length for a radon atom is only a few meters at most before it decays, and since no mining operations have taken place within 50 meters of any on the homes, it is unlikely that the mining operations have in any way affected the soil gas radon concentrations near the homes.

Since these two sites are not "normal" sites as far as the potential for outdoor concentrations of radon, the additional question might be asked, "Could these homes be affected by airborne radon from nearby exposed uranium seams or open mine shafts?". It is difficult to answer "No" to such a speculative question, since outdoor concentration measurements have never been made to my

nowledge. However, it is very unlikely that increases in outdoor concentrations near the homes have occurred as a result of mining operations. The distance of the homes from any potential airborne sources plus the vast volume of mixing air between source and receptor support this conclusion. Indirectly, it must be noted that while radon soil gas measurements have been used as a prospecting tool, radon air concentration measurements have never been used to prospect for uranium. This indicates that increased air concentrations are not associated with rich uranium soil deposits, and thus one would not expect to see any increase in airborne radon concentrations near the homes on these sites.

In conclusion, it does not appear that any increased indoor radon concentrations should be expected or have been measured at the homes on the Vandever and Desiderio sites. Additional long-term measurements following EPA protocols may help clarify this conclusion. It is recommended that any new home construction, particularly on land included as part of this removal action, include piping and sub-foundation gravel consistent with EPA recommendations for new home construction, so that if elevated concentrations are encountered (as have been in 8.3% of the homes in the IHS study), mitigation procedures will be cheap and effective.

DRAFT

TO: Art Ball, EPA Work Assignment Manager

FROM: Gerald L. Gels, REAC Task Leader

THRU: Gary Buchanan, O&A Section Chief

SUBJECT: BLUEWATER URANIUM MINE SITES
WORK ASSIGNMENT #3-547 -TRIP REPORT

DATE: December 11, 1992

BACKGROUND

In November of 1990, the Federal Agency for Toxic Substance and Disease Registry (ATSDR) issued a Public Health Advisory concerning the Bluewater Uranium Mine Sites. This followed a preliminary assessment by U.S. EPA and several meetings among a number of federal and state agencies as well as Navajo representatives and former owners of the mineral rights. The result was an Action Memorandum directing the U.S. EPA Emergency Response Section (ERS) to conduct a removal action. The first phase of the removal action was completed in September of 1991 which consisted of work at the Brown Vandeveer, the Nanabah-Vandeveer, and the Desiderio parcels. In 1992, U.S.EPA Region IX reached an agreement with the U.S. Department of Energy to take the lead in remediating the parcel controlled by the U.S.DOE. The ERS tasked the U.S. EPA Environmental Response Team (ERT) who in turn tasked the Response Engineering Analytical Contractor (REAC, Roy F. Weston, Inc.) with assisting in this removal action.

The Phase I Bluewater Uranium Mine Sites consisted of three parcels of land located about 15-20 miles NNW of Grants, NM (see Figure 1). Two of the parcels, Nanabah-Vandever (Section 24) and Brown-Vandever (Section 18), are at the base of Haystack Mountain, on the southern flank, at an altitude of about 7000 ft above sea level. The third parcel, Navajo-Desiderio is about 5 miles ESE of the others at about the same altitude. All three of the sites were strip-mined for uranium between 1952 and 1970. In addition, subsurface mining also took place at the Brown-Vandever and the Desiderio parcels. Subsurface mining was the employed exclusively at the Phase II DOE section, Section 13. Piles of rubble and low-grade ore were left at all four sites, with gamma radiation levels ranging from background [~15 microroentgens per hour (μR/hr)] to about 1000 μR/hr in some places.

For Phase II, REAC was mobilized by ERT Work Assignment Manager Art Ball and tasked with providing Health Physics coverage for workers at the Bluewater Site and with conducting gamma surveys of the site both before and after the removal action. Task Leader, Gerald Gels, wrote a Work Plan and Health and Safety Plan and assembled radiation equipment from the Cincinnati REAC office. Craig Dodd of the Cincinnati REAC office was the initial responder to the Bluewater site during the second week of November, 1992.

OBSERVATIONS AND ACTIVITIES

The above personnel and equipment arrived in Grants, NM, on November 9, 1992. Prior to going to the site,

several activities occurred. The REAC Task Leader had previously made a calculation of the dust concentration in air that would require respiratory protection (see Appendix A). Conservative assumptions were made; namely, that the maximum soil radionuclide concentrations measured during the EPA preliminary assessment were present in all airborne dust, that this dust was present for 60 hours per week, and that no respiratory protection was employed. The calculated concentration of dust in air at which Level C respiratory protection would be required was 170 micrograms of dust per liter of air (μg/L). During Phase I, on-site measurements at numerous locations and times indicated that short-term dust concentrations were less than 1% of this value.

Activities at Bluewater were divided into 4 categories:

- Constructing gamma survey grids;
- Health physics coverage of the site and workers;
- Checks on reclamation activities; and,
- Miscellaneous health physics assignments at the request of the Work Assignment Manager.

The gamma survey grid category can be further subdivided into Pre- and Post- reclamation subcategories.

Gamma Survey Grid (Pre-reclamation)

A Pre-reclamation gamma survey was performed on November 9, 1992 by the U.S.EPA On-Scene Coordinator (OSC), Robert Bornstein and the U.S.EPA-ERT Work Assignment Manager, Art Ball. The data was entered into the Surfer software package and results were displayed in graphical fashion. Three distinct areas of elevated gamma activity were noted, west of the mine portal, and at the two ore pads.

Health Physics Coverage

All non-resident personnel entering each site while work was being conducted were required to log in at the checkpoint established at the mobilization trailer at the site. All contractor equipment was surveyed thoroughly prior to final demobilization. No contamination was detected. Daily airborne dust concentration measurements were taken (see Appendix B) to determine whether respiratory protection was required (per Appendix A). At no time did any measured dust concentration reach even 1% of the level that would require level C respiratory protection. Airborne alpha concentration data are presented in Appendix C. Over the approximate 3-week period of time during which earth moving operations were taking place, the calculated dose due to inhalation of airborne dust at the Phase II Bluewater Mine Site was approximately 0.XX millirem (mrem) committed effective dose equivalent (cede). This additional dose is approximately comparable to the background dose a person would receive from natural sources in XX hour.

Radiation Measurements During Reclamation

Using the pre-reclamation gamma radiation contours, the general reclamation strategy was to move the highest activity material into low-lying areas. After that, clean dirt was brought in from other areas of the site to cover and contour the slopes. The site was then graded for erosion control and proper drainage. A channel was constructed on the north side of the affected area to direct water from the slopes of Haystack Mountain around and away from the remediated area. During the reclamation process, progress was checked frequently using the Ludlum model 19 microR meter. When problems were uncovered, immediate corrective actions were taken.

Gamma Survey Grid (Post-reclamation)

The U.S. EPA objective for site reclamation was an average waist-level gamma radiation level of less than 165 μR/hr. A post-reclamation waist-level gamma survey on the DOE Section 13 was conducted beginning on November 21, 1992. No significant hot spots were discovered. All data for Section 13 was at or below 60 μR/hr, with the mean value of XX μR/hr, well within the site objective. Signs were installed at several locations around Section 13, stating in 3 languages (English, Navajo and Spanish), "Potential Radiological Hazard Below Surface."

During a Phase I general site survey, one area of exposed rock was discovered which read 50 to 55 μR/hr at

waist level in an area that had obviously had no mining activities. This provides a point of comparison by which the EPA efforts at these sites can be judged.

Soil Sampling

At the end of field activities, a site composite surface soil sample was collected from the remediated area of Section 13. This sample was analyzed for ^{226}Ra activity using a 3" by 3" sodium iodide (NaI) detector and gamma spectrometer by REAC personnel and compared to a 50 pCi/g U.S.EPA soil radium standard. The results of this analysis indicate an average ^{226}Ra soil concentration after remediation of 0.6 ± 0.2 pCi/g.

CONCLUSIONS AND RECOMMENDATIONS

Field operations went as planned and were successful. Average and maximum post-reclamation radiation levels were well below the target levels set prior to commencement of work. No detectable contamination was found on any personnel or equipment. Radiation doses to personnel due to inhalation of airborne dust from the site were also estimated to be very low, averaging less than 1 mrem per year. No future activities are planned.

BLUEWATER URANIUM AIR-001

LOCATION: East Side of the Soil Removal Area, Next to the Road, Pump #1
START TIME/FLOW 11/11/92, 08:55, 3.5 cfm
STOP TIME/FLOW 11/11/92, 16:55, 3.5 cfm
AIR VOLUME: 3.5 cfm * 480 min =47572.56 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/11/92	22	0		54	1	54.00	0.9166666	33919.916667	147.1232	1.39E-12
11/12/92	21	25		14	10	1.40	0.8923611	33920.892361	3.013698	2.85E-14
11/13/92	21	0		2	10	0.20	0.875	33921.875	-0.27397	*********
11/14/92	18	10		4	10	0.40	0.7569444	33922.756944	0.273972	2.59E-15
11/15/92	21	10		3	10	0.30	0.8819444	33923.881944	0	0.00E+00
11/16/92	21	5		6	10	0.60	0.8784722	33924.878472	0.821917	7.78E-15
11/17/92	21	10		0	10	0.00	0.8819444	33925.881944	-0.82191	*********
12/09/92	10	17		2	30	0.07	0.4284722	33947.428472	-0.63926	*********

BLUEWATER URANIUM AIR-002

LOCATION: East Side of the Soil Removal Area, Pump #1
START TIME/FLOW 11/12/92, 08:55, 3.5 cfm
STOP TIME/FLOW 11/12/92, 16:55, 3.5 cfm
AIR VOLUME: 3.5 cfm * 480 min =47572.56 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/12/92	21	50		683	10	68.30	0.9097222	33920.909722	186.3013	1.76E-12
11/13/92	6	10		372	10	37.20	0.2569444	33921.256944	101.0958	9.57E-13
11/13/92	22	10		138	10	13.80	0.9236111	33921.923611	36.98630	3.50E-13
11/14/92	18	25		36	10	3.60	0.7673611	33922.767361	9.041095	8.56E-14
11/15/92	21	25		7	10	0.70	0.8923611	33923.892361	1.095890	1.04E-14
11/16/92	21	25		7	10	0.70	0.8923611	33924.892361	1.095890	1.04E-14
11/17/92	21	30		2	10	0.20	0.8958333	33925.895833	-0.27397	*********
11/18/92	21	40		7	10	0.70	0.9027777	33926.902778	1.095890	1.04E-14
11/19/92	22	4		2	10	0.20	0.9194444	33927.919444	-0.27397	*********
11/20/92	21	5		5	10	0.50	0.8784722	33928.878472	0.547945	5.19E-15
12/09/92	8	49		6	30	0.20	0.3673611	33947.367361	-0.27397	*********

BLUEWATER URANIUM AIR-003

LOCATION: 500 yds NE of Tails Area, at Base of Haystack Mesa, Pump #1
START TIME/FLOW 11/13/92, 07:50, 4.0 cfm
STOP TIME/FLOW 11/13/92, 16:50, 4.0 cfm
AIR VOLUME: 4 cfm * 540 min =61164.72 L

	TIME								
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/13/92	22	25		548	10	54.80	0.9340277	33921.934028	149.3150	1.10E-12
11/14/92	18	40		137	10	13.70	0.7777777	33922.777778	36.71232	2.70E-13
11/15/92	21	40		17	10	1.70	0.9027777	33923.902778	3.835616	2.82E-14
11/16/92	21	40		9	10	0.90	0.9027777	33924.902778	1.643835	1.21E-14
11/17/92	21	40		4	10	0.40	0.9027777	33925.902778	0.273972	2.02E-15
11/18/92	21	50		5	10	0.50	0.9097222	33926.909722	0.547945	4.04E-15
11/19/92	21	43		6	10	0.60	0.9048611	33927.904861	0.821917	6.05E-15
11/20/92	20	46		4	10	0.40	0.8652777	33928.865278	0.273972	2.02E-15
12/08/92	17	45		9	30	0.30	0.7395833	33946.739583	0	0.00E+00

BLUEWATER URANIUM AIR-004

LOCATION: Canyon Point across from West End of Drainage Ditch, Pump #1
START TIME/FLOW 11/14/92, 07:55, 4.0 cfm
STOP TIME/FLOW 11/14/92, 15:30, 4.0 cfm
AIR VOLUME: 4 cfm * 455 min =51536.94 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/14/92	19	10		893	10	89.30	0.7986111	33922.798611	243.8356	2.13E-12
11/15/92	21	55		138	10	13.80	0.9131944	33923.913194	36.98630	3.23E-13
11/16/92	21	55		32	10	3.20	0.9131944	33924.913194	7.945205	6.94E-14
11/17/92	21	50		9	10	0.90	0.9097222	33925.909722	1.643835	1.44E-14
11/18/92	22	10		5	10	0.50	0.9236111	33926.923611	0.547945	4.79E-15
11/19/92	21	28		3	10	0.30	0.8944444	33927.894444	0	0.00E+00
11/20/92	20	24		0	10	0.00	0.85	33928.85	-0.82191	*********
11/21/92	19	17		19	50	0.38	0.8034722	33929.803472	0.219178	1.92E-15
11/22/92	16	35		2	10	0.20	0.6909722	33930.690972	-0.27397	*********
12/08/92	16	22		7	30	0.23	0.6819444	33946.681944	-0.18264	*********

BLUEWATER URANIUM AIR-005

LOCATION: Center East Side above Tails on Rock Wall, Pump #1
START TIME/FLOW 11/16/92, 08:05, 3.7 cfm
STOP TIME/FLOW 11/16/92, 16:50, 3.7 cfm
AIR VOLUME: 3.7 cfm * 525 min =55005.77 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/16/92	22	5		1061	10	106.10	0.9201388	33924.920139	289.8630	2.37E-12
11/17/92	22	5		215	10	21.50	0.9201388	33925.920139	58.08219	4.76E-13
11/18/92	22	20		49	10	4.90	0.9305555	33926.930556	12.60273	1.03E-13
11/19/92	21	12		18	10	1.80	0.8833333	33927.883333	4.109589	3.37E-14
11/20/92	19	10		9	10	0.90	0.7986111	33928.798611	1.643835	1.35E-14
11/21/92	19	5		10	10	1.00	0.7951388	33929.795139	1.917808	1.57E-14
11/22/92	14	29		4	10	0.40	0.6034722	33930.603472	0.273972	2.24E-15
11/22/92	14	49		32	50	0.64	0.6173611	33930.617361	0.931506	7.63E-15
11/23/92	20	50		41	50	0.82	0.8680555	33931.868056	1.424657	1.17E-14
11/24/92	17	22		7	10	0.70	0.7236111	33932.723611	1.095890	8.97E-15
12/08/92	15	32		20	30	0.67	0.6472222	33946.647222	1.004566	8.23E-15

BLUEWATER URANIUM AIR-006

LOCATION: Center East Side above Tails on Rock Wall, Pump #1
START TIME/FLOW 11/17/92, 07:35, 3.8 cfm
STOP TIME/FLOW 11/17/92, 16:40, 3.5 cfm
AIR VOLUME: 3.65 cfm * 545 min =56329.59 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/17/92	22	20		652	10	65.20	0.9305555	33925.930556	177.8082	1.42E-12
11/18/92	22	30		119	10	11.90	0.9375	33926.9375	31.78082	2.54E-13
11/19/92	20	49		38	10	3.80	0.8673611	33927.867361	9.589041	7.67E-14
11/20/92	18	59		20	10	2.00	0.7909722	33928.790972	4.657534	3.72E-14
11/21/92	18	53		4	10	0.40	0.7868055	33929.786806	0.273972	2.19E-15
11/22/92	13	31		4	10	0.40	0.5631944	33930.563194	0.273972	2.19E-15
11/23/92	20	33		6	10	0.60	0.85625	33931.85625	0.821917	6.57E-15
11/24/92	17	10		8	10	0.80	0.7152777	33932.715278	1.369863	1.10E-14
12/08/92	14	42		13	30	0.43	0.6125	33946.6125	0.365296	2.92E-15

BLUEWATER URANIUM AIR-007

LOCATION: Center East Side above Tails on Rock Wall, Pump #1
START TIME/FLOW 11/18/92, 07:50, 3.8 cfm
STOP TIME/FLOW 11/18/92, 16:40, 3.6 cfm
AIR VOLUME: 3.7 cfm * 530 min =55529.63 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/18/92	22	45		778	10	77.80	0.9479166	33926.947917	212.3287	1.72E-12
11/19/92	20	31		195	10	19.50	0.8548611	33927.854861	52.60273	4.27E-13
11/20/92	18	45		59	10	5.90	0.78125	33928.78125	15.34246	1.24E-13
11/21/92	18	27		16	10	1.60	0.76875	33929.76875	3.561643	2.89E-14
11/22/92	12	46		6	10	0.60	0.5319444	33930.531944	0.821917	6.67E-15
11/23/92	20	18		6	10	0.60	0.8458333	33931.845833	0.821917	6.67E-15
11/24/92	16	59		5	10	0.50	0.7076388	33932.707639	0.547945	4.44E-15
12/08/92	14	11		11	30	0.37	0.5909722	33946.590972	0.182648	1.48E-15

BLUEWATER URANIUM AIR-008

LOCATION: Center East Side above Tails on Rock Wall, Pump #1
START TIME/FLOW 11/19/92, 07:40, 3.8 cfm
STOP TIME/FLOW 11/19/92, 16:40, 3.5 cfm
AIR VOLUME: 3.65 cfm * 540 min =55812.80 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/19/92	20	1		535	10	53.50	0.8340277	33927.834028	145.7534	1.18E-12
11/20/92	18	29		142	10	14.20	0.7701388	33928.770139	38.08219	3.07E-13
11/21/92	18	11		30	10	3.00	0.7576388	33929.757639	7.397260	5.97E-14
11/22/92	12	9		14	10	1.40	0.50625	33930.50625	3.013698	2.43E-14
11/23/92	20	7		6	10	0.60	0.8381944	33931.838194	0.821917	6.63E-15
11/24/92	16	45		1	10	0.10	0.6979166	33932.697917	-0.54794	*********
12/08/92	13	31		19	30	0.63	0.5631944	33946.563194	0.913242	7.37E-15

BLUEWATER URANIUM AIR-009

LOCATION: Rocky Outcrop, Central Area of Site, Pump #1
START TIME/FLOW 11/20/92, 08:00, 3.5 cfm
STOP TIME/FLOW 11/20/92, 16:30, 3.4 cfm
AIR VOLUME: 3.45 cfm * 510 min =49823.76 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/20/92	18	16		718	10	71.80	0.7611111	33928.761111	195.8904	1.77E-12
11/20/92	21	46		251	10	25.10	0.9069444	33928.906944	67.94520	6.14E-13
11/21/92	6	20		151	10	15.10	0.2638888	33929.263889	40.54794	3.67E-13
11/21/92	17	52		72	10	7.20	0.7444444	33929.744444	18.90410	1.71E-13
11/22/92	11	37		21	10	2.10	0.4840277	33930.484028	4.931506	4.46E-14
11/22/92	17	18		16	10	1.60	0.7208333	33930.720833	3.561643	3.22E-14
11/23/92	19	49		8	10	0.80	0.8256944	33931.825694	1.369863	1.24E-14
11/24/92	16	34		0	10	0.00	0.6902777	33932.690278	-0.82191	*********
12/08/92	12	12		7	30	0.23	0.5083333	33946.508333	-0.18264	*********

BLUEWATER URANIUM AIR-010

LOCATION: Rocky Outcrop, Central Area of Site, Pump #1
START TIME/FLOW 11/21/92, 07:58, 3.6 cfm
STOP TIME/FLOW 11/21/92, 15:04, 3.5 cfm
AIR VOLUME: 3.55 cfm * 426 min =42823.79 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/21/92	17	35		790	10	79.00	0.7326388	33929.732639	215.6164	2.27E-12
11/21/92	21	41		260	10	26.00	0.9034722	33929.903472	70.41095	7.41E-13
11/22/92	11	23		102	10	10.20	0.4743055	33930.474306	27.12328	2.85E-13
11/22/92	16	49		55	10	5.50	0.7006944	33930.700694	14.24657	1.50E-13
11/23/92	6	20		24	10	2.40	0.2638888	33931.263889	5.753424	6.05E-14
11/23/92	19	38		11	10	1.10	0.8180555	33931.818056	2.191780	2.31E-14
11/24/92	16	20		4	10	0.40	0.6805555	33932.680556	0.273972	2.88E-15
12/08/92	11	19		5	30	0.17	0.4715277	33946.471528	-0.36529	*********

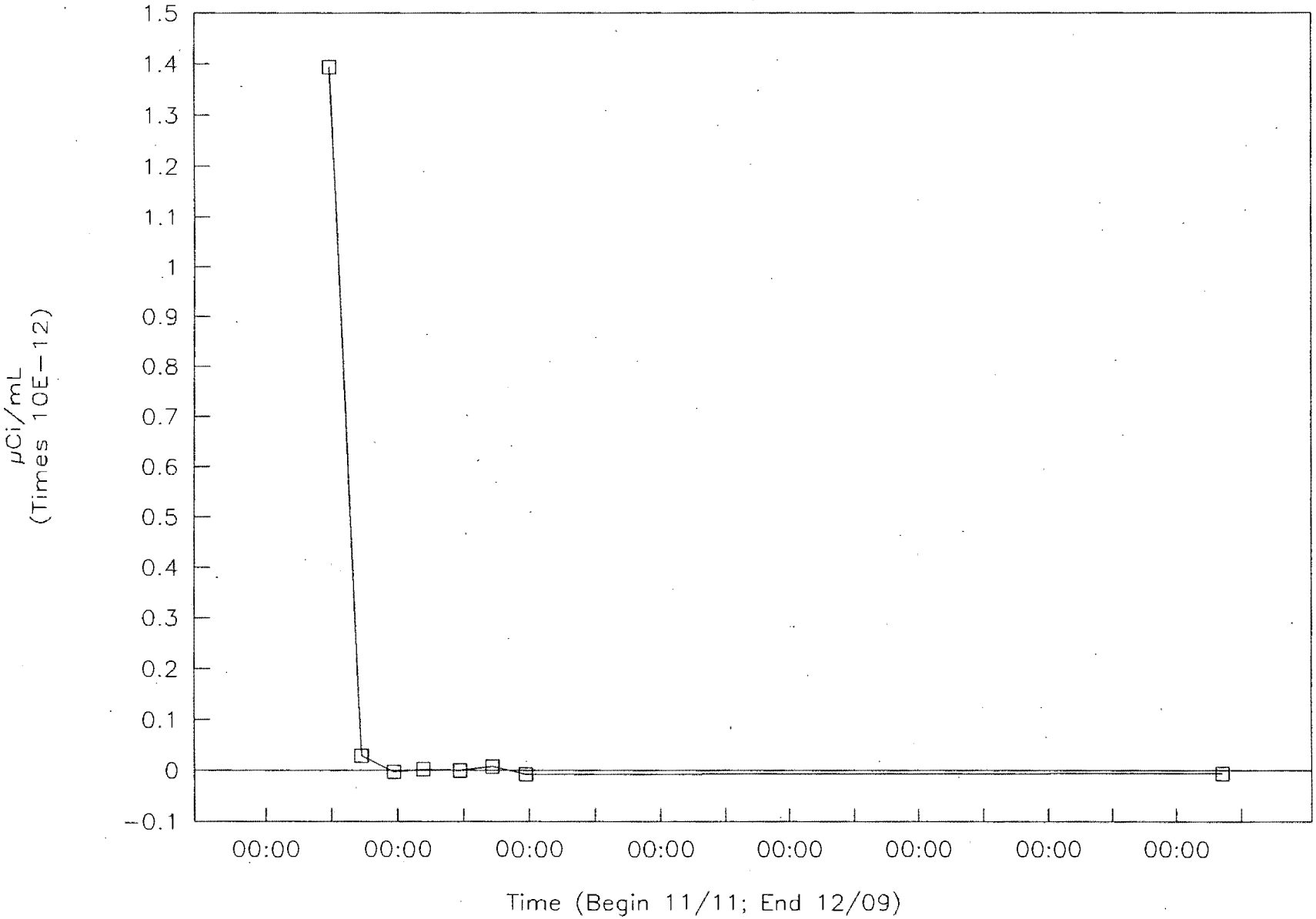
BLUEWATER URANIUM AIR-011

LOCATION: Rocky Outcrop, Central Area of Site, Pump #1
START TIME/FLOW 11/23/92, 07:30, 3.6 cfm
STOP TIME/FLOW 11/23/92, 15:50, 3.4 cfm
AIR VOLUME: 3.5 cfm * 500 min =49554.75 L

	TIME									
DATE	HRS	MIN	SEC	Counts	Time	C/m	TIME CODE	TOT CODE	Net d/m	uCi/mL
11/23/92	19	26		334	10	33.40	0.8097222	33931.809722	90.68493	8.24E-13
11/23/92	21	56		296	10	29.60	0.9138888	33931.913889	80.27397	7.30E-13
11/24/92	6	8		177	10	17.70	0.2555555	33932.255556	47.67123	4.33E-13
11/24/92	16	7		87	10	8.70	0.6715277	33932.671528	23.01369	2.09E-13
12/08/92	9	36		13	30	0.43	0.4	33946.4	0.365296	3.32E-15

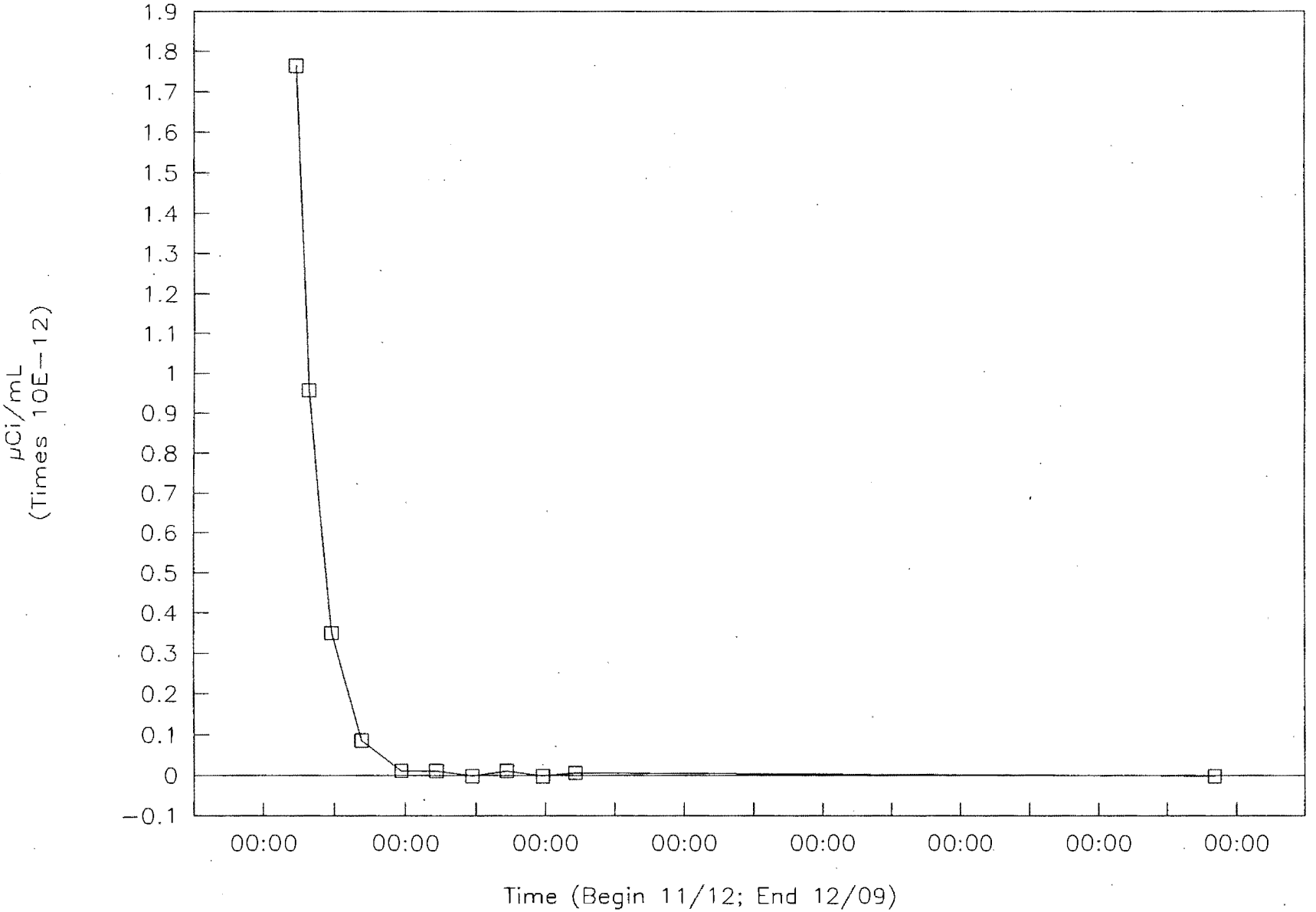
Bluewater Sample AIR-001

Start 22:00, 11/11/92



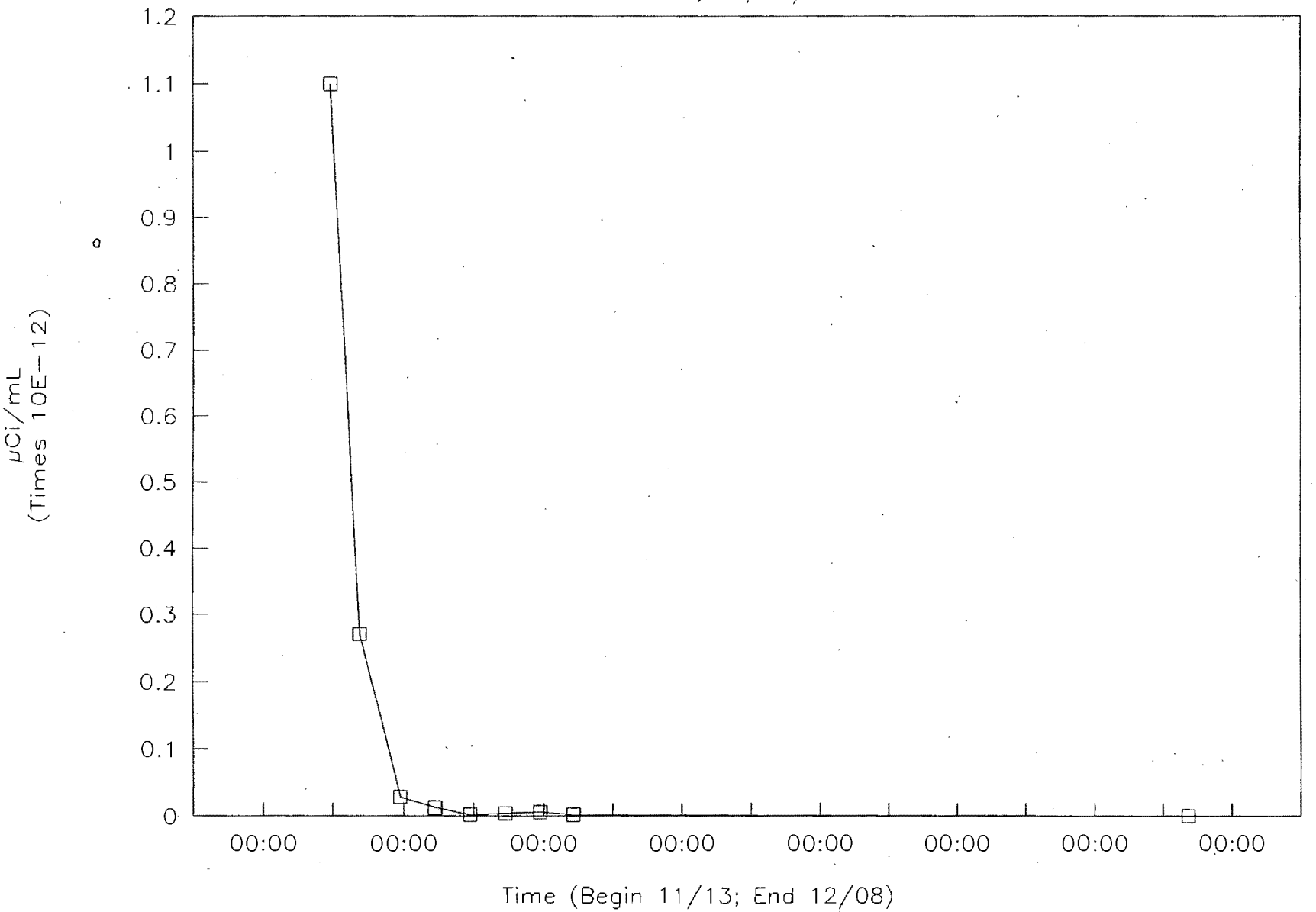
Bluewater Sample AIR-002

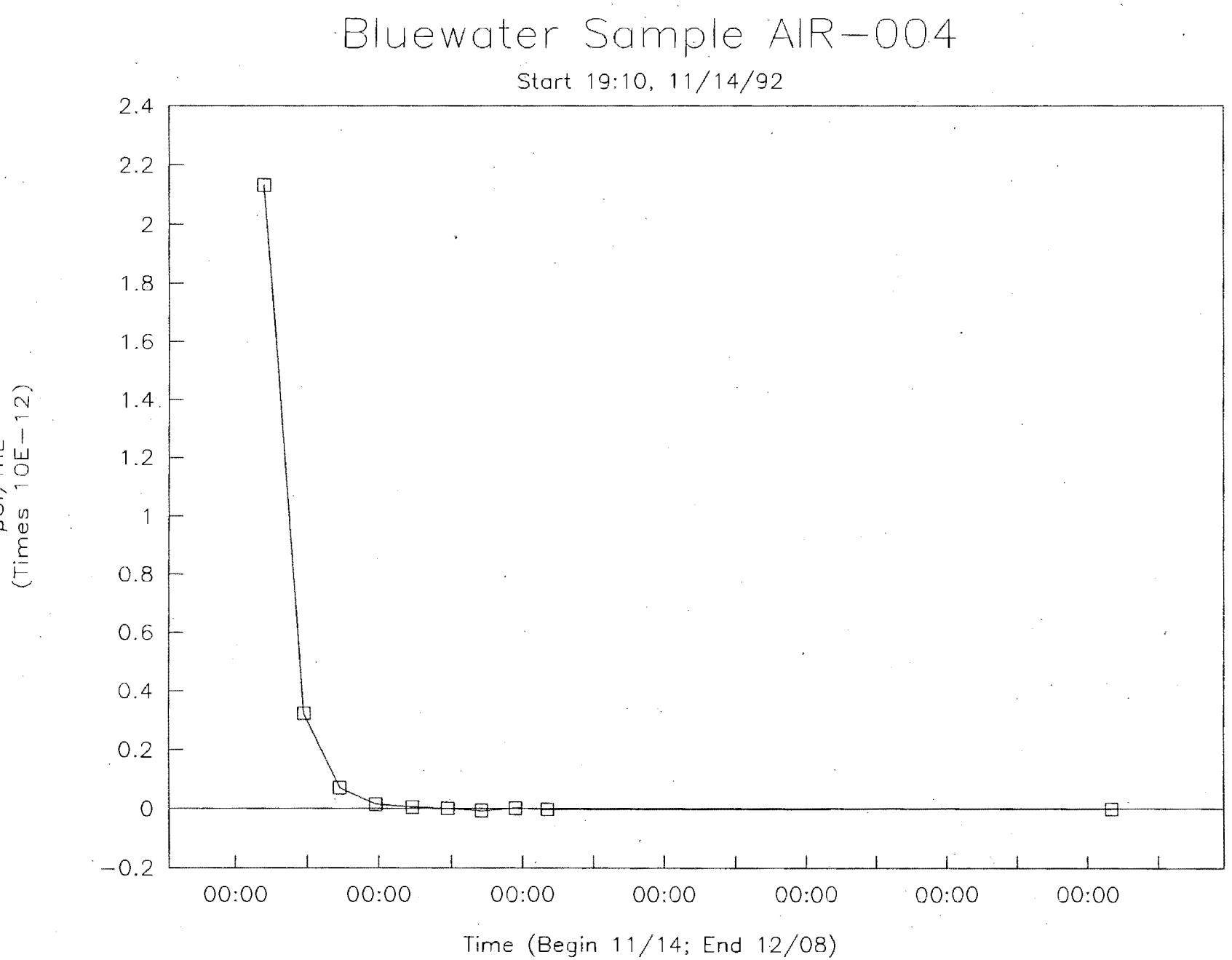
Start 21:50, 11/12/92



Bluewater Sample AIR-003

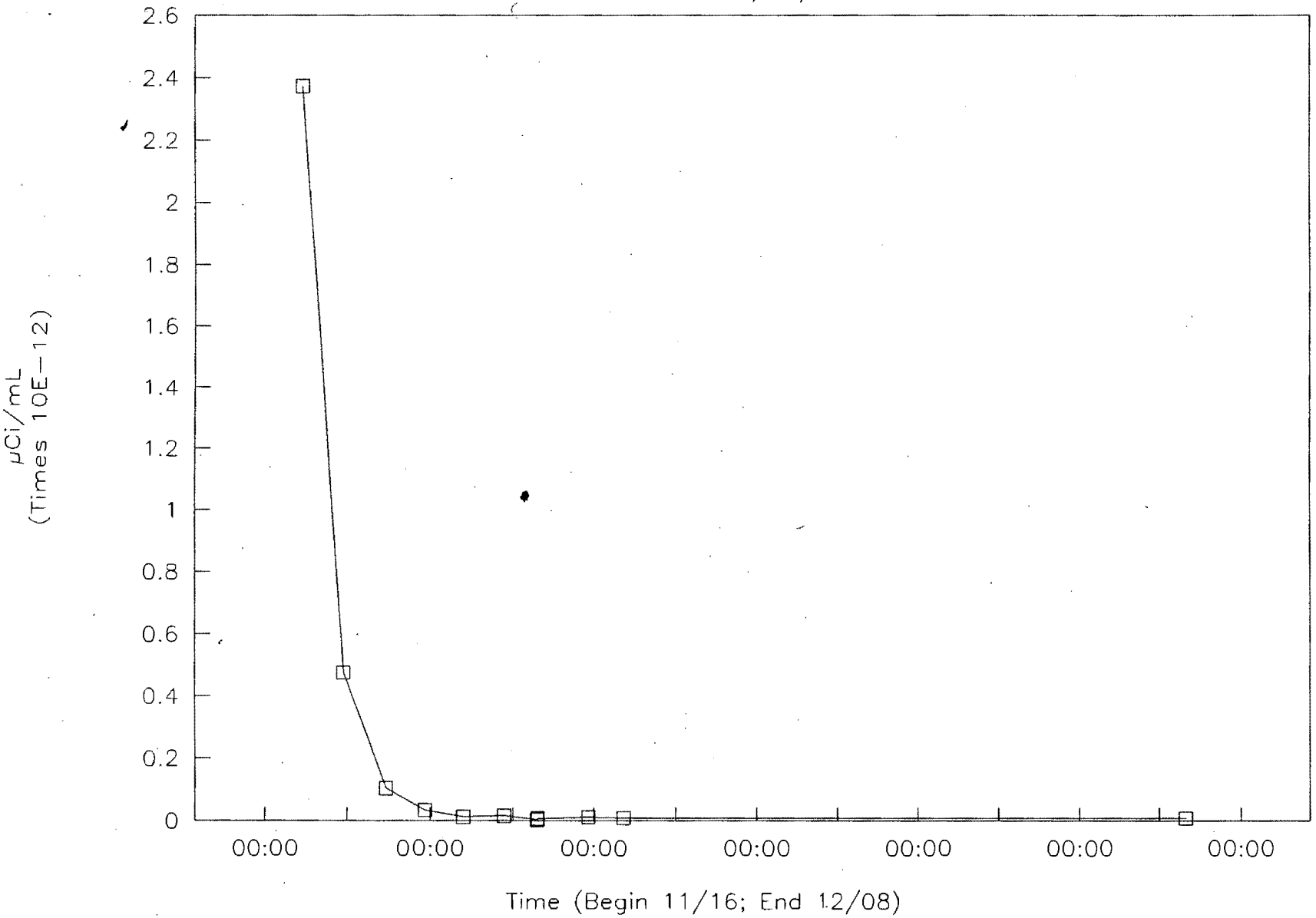
Start 22:25, 11/13/92




Bluewater Sample AIR-004
Start 19:10, 11/14/92
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
µCi/mL
(Times 10E-12)
00:00
00:00
00:00
00:00
00:00
00:00
00:00
Time (Begin 11/14; End 12/08)

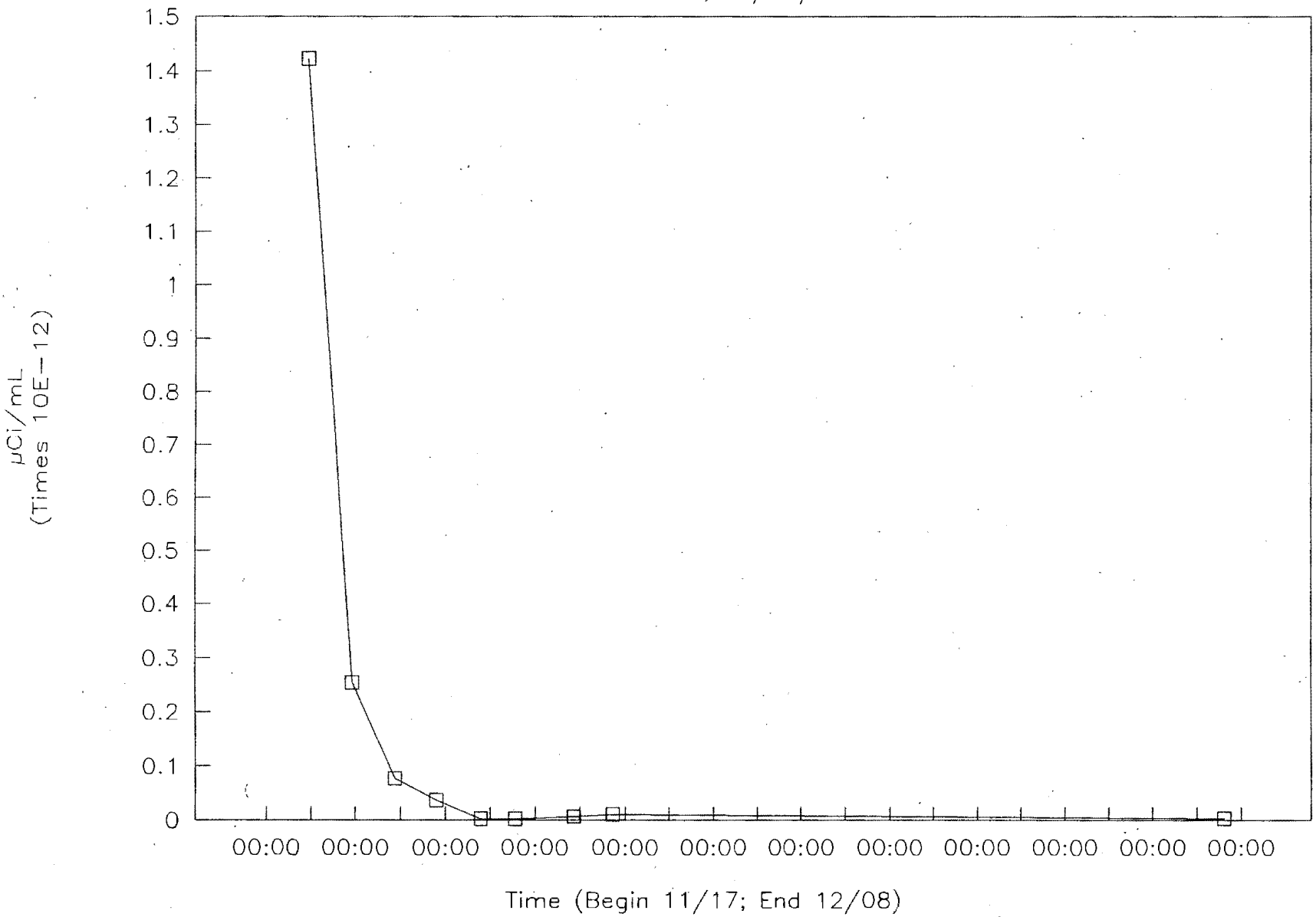
Bluewater Sample AIR-005

Start 22:05, 11/16/92



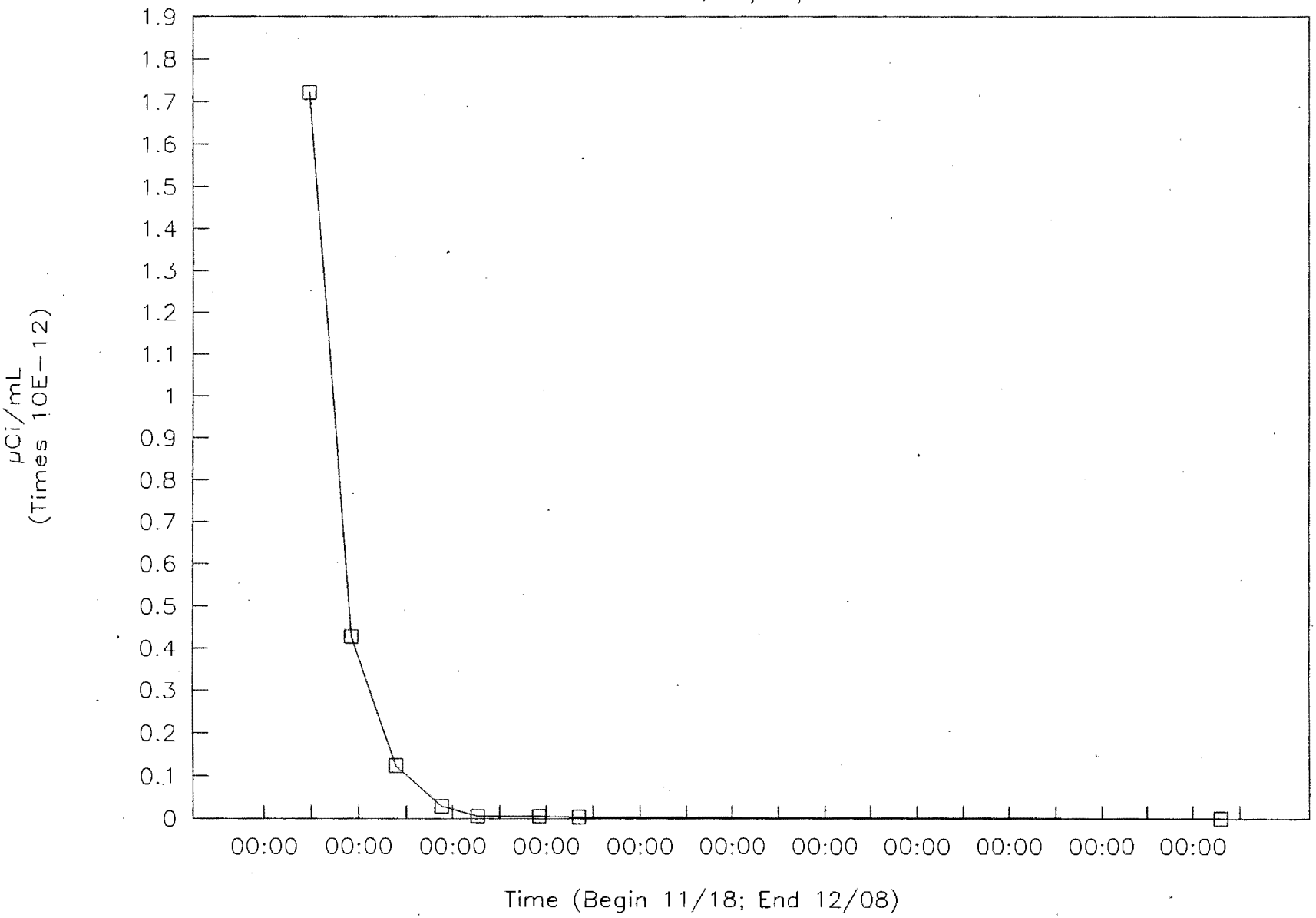
Bluewater Sample AIR-006

Start 22:20, 11/17/92



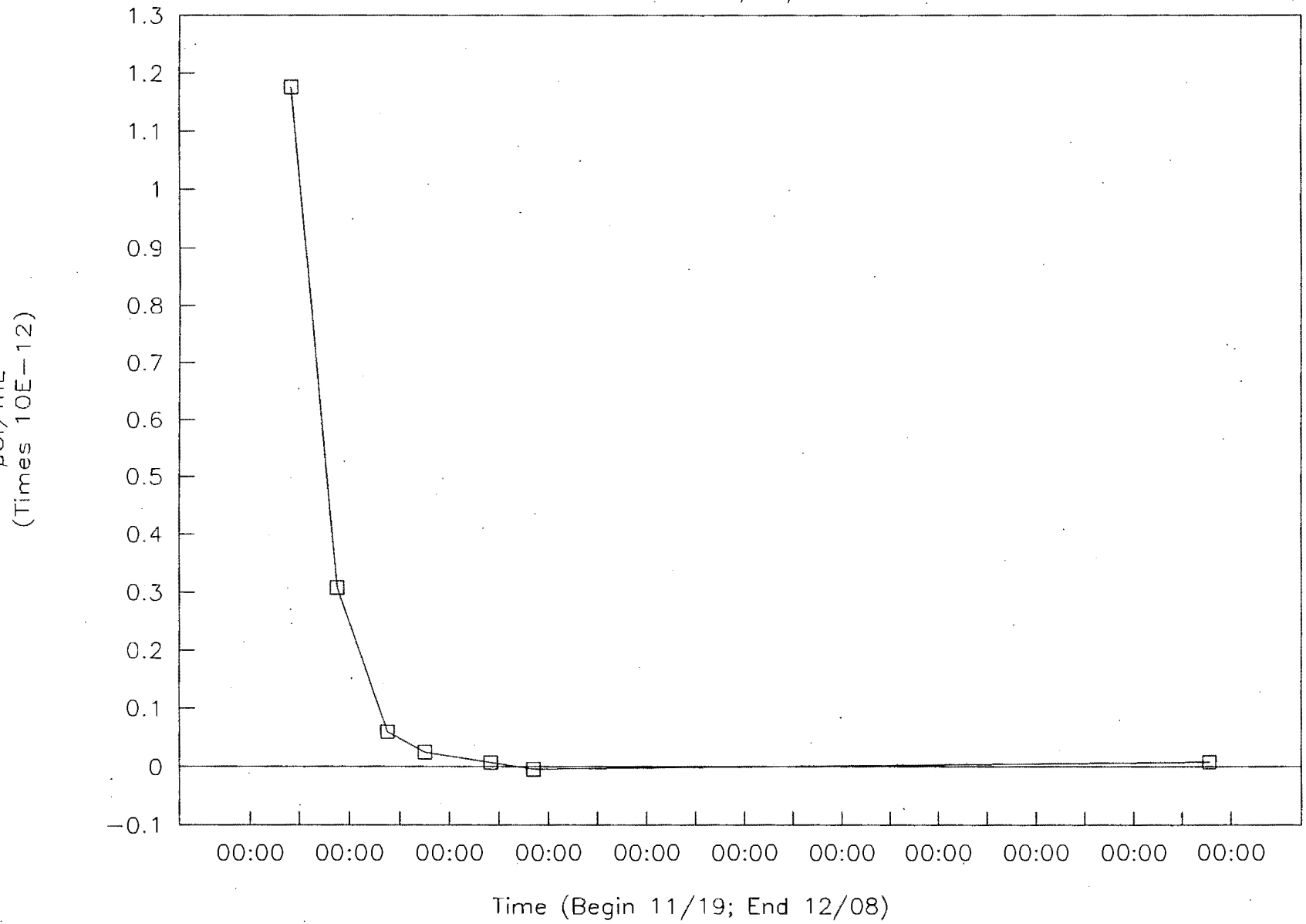
Bluewater Sample AIR-007

Start 22:45, 11/18/92



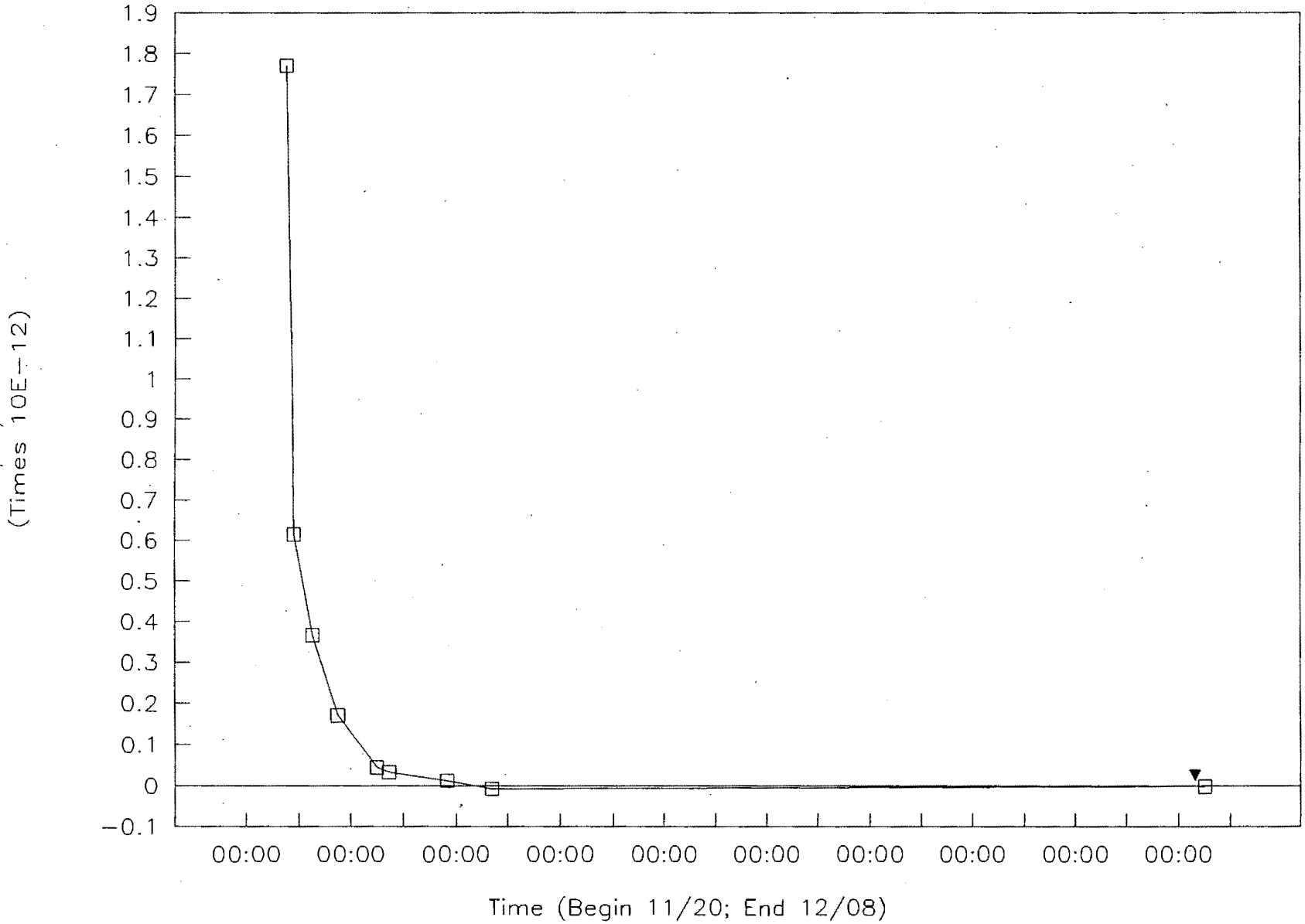
Bluewater Sample AIR-008

Start 20:01, 11/19/92



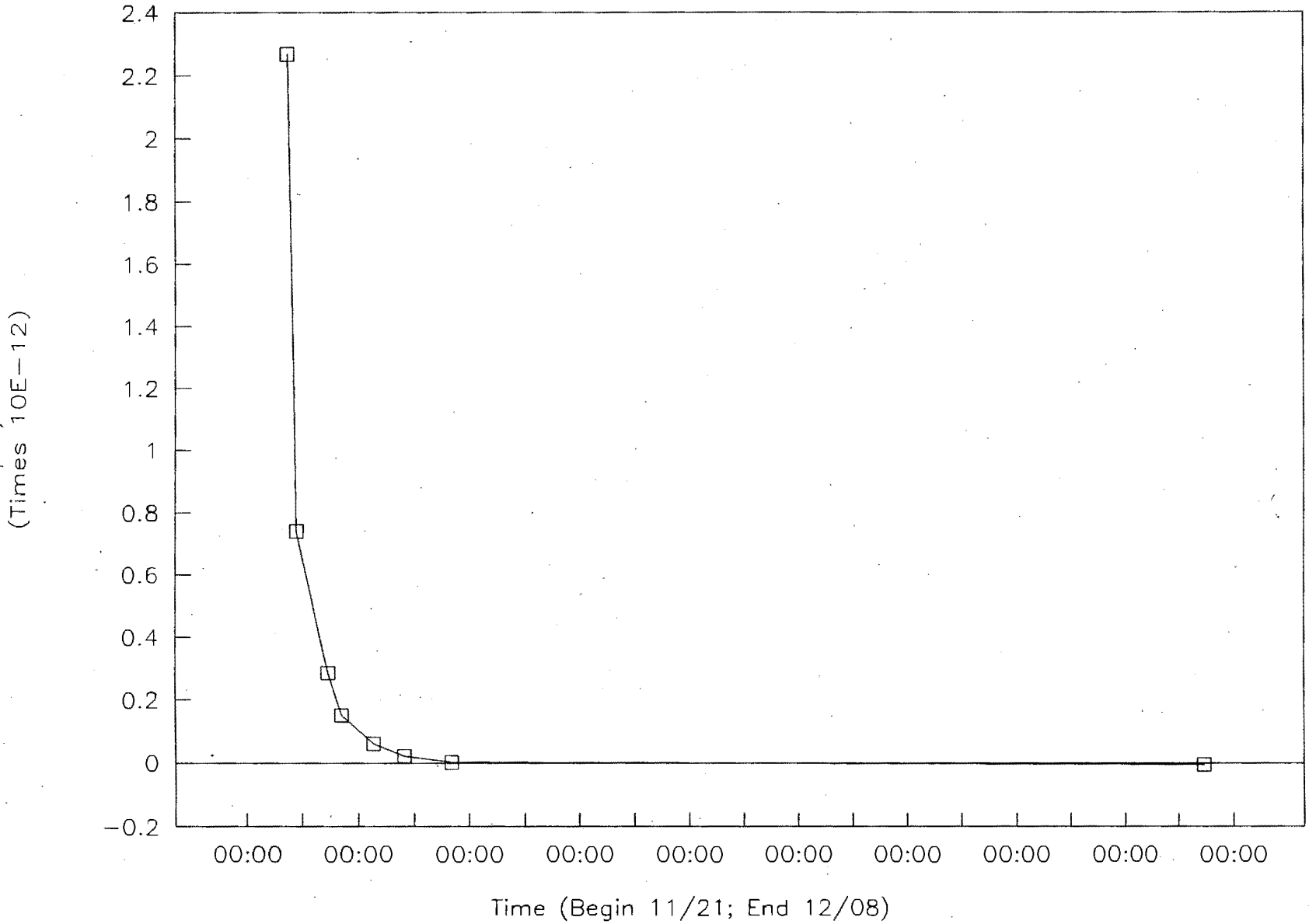
Bluewater Sample AIR-009

Start 18:16, 11/20/92



Bluewater Sample AIR-010

Start 17:35, 11/21/92



Bluewater Sample AIR-011

Start 19:26, 11/23/92